EDITORIAL

LATEST TV statistics show a steady increase in listeners for both Sydney and Melbourne.

The recent dull period seems to have brightened, and, given some good football matches, sales should quicken through the winter. Interest in TV throughout the Sydney Show period emphasised again that nothing sells sets like programs.

Now where do we go from here? Why not proceed immediately with stations in other capital cities?

If there are people ready and able to start business, they should be given the opportunity.

No doubt a public hearing will be necessary to decide who shall have licenses, and that will take some time. But if a start is made now, we could have some new TV stations in operation during the first half of next year.

And that will be quite late enough.

From now on, the growth of TV must be vigorous, courageous, and rapid. We just can't afford to look back. We must continue to widen the scope for those who have risked their money to make it possible. Only by vastly increasing the turn-over in TV can we make it better and make it cheaper.

New TV stations throughout the country will ease some of the problems of the station owners. They will have others to share their programs, their experience, their costs. Every new station will help to build up the strength of the whole industry.

It is possible that the ABC might be embarrassed if faced with the need to build new stations at an early date, particularly as its efforts so far have lagged behind its commercial contemporaries.

This isn't a cut at the ABC whose task in building a national TV service is very great and whose procedures may not be speedy.

But there is no reason why others should not be given their chance as soon as possible.

For the set manufacturer it is absolutely essential that a steady and adequate market for sets is built up if quality is to be good and prices low. Nothing will hamper the industry more than a production line which works in fits and starts.

That's the best way to make certain that some day it won't work at all.

All this means that we cannot be half-hearted or timid about TV. Its here now, the public wants it, and should get it, everywhere, as soon as our best efforts can bring this about.

John Moyle

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OUR COVER PICTURE

SHADE OF THE FUTURE—Nuclear power is extending its applications rapidly for power plants, large and small. Here is Britain's latest submarine—details secret—powered by an atom plant, coming into port after an experimental cruise.

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0-250	0-5	9 ranges of W
0-500	0-20	3 for each voltage

EXTRAS: Leather carrying case external rela box for 3-phase testing. Current and potential formers for extending ranges supplied at extra

DIMENSIONS: The Palec Power Analyser is hou an exclusive semi-hard rubber case, size 8 inch 9¼ inches by 4½ inches overall. Weight 8lb.

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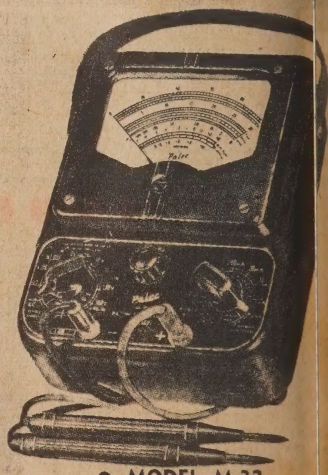
Volts A.C. 0/3-10-30-100-300-1000	6
Current D.C. 0/1-3-10-30-100-300 mA.-1-3-10 amp.	9
Current A.C. 0/1 mA. (for use with ext. current transformers)	1
Ohms 1-10 megohms	3
Decibels Ref. level 1 mW. in 600 ohms	3
Decibels Ref. level 6 mW. in 600 ohms	3
Total	32

T.V. NOTE: External probe available for Model MX32 to extend range to 30,000 Volts DC.

TRADE PRICES
Model M32, £17/18/6. Model MX32, £25/17/6. All prices plus Sales Tax.



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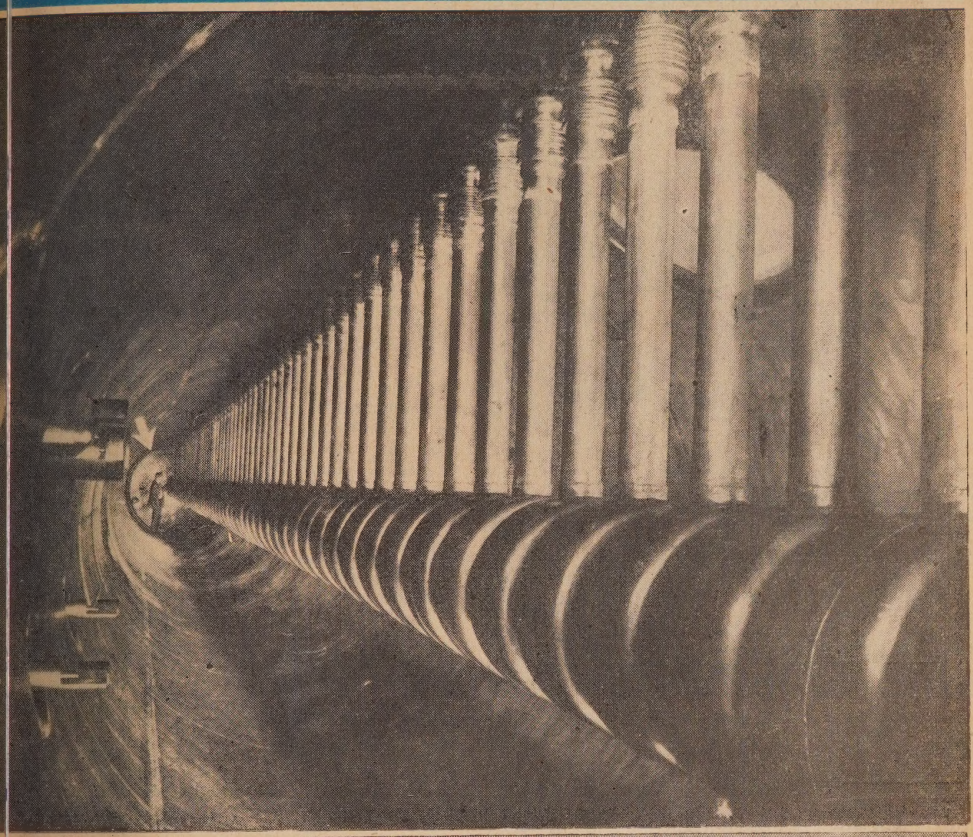
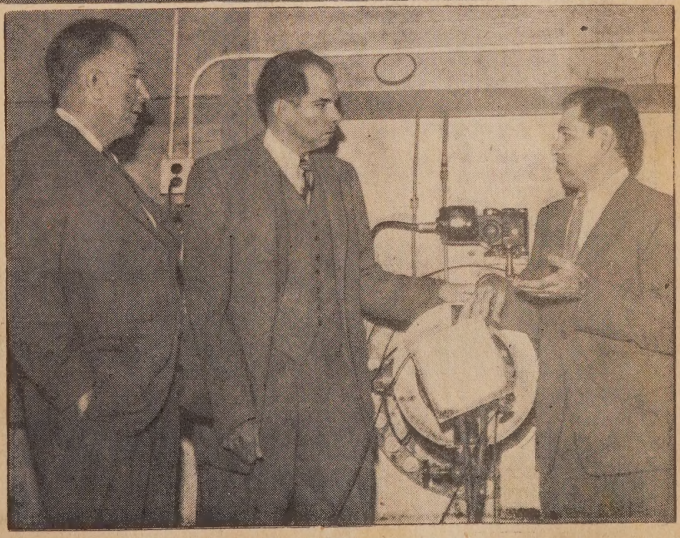
INTERIOR OF NEW ATOM SMASHER



The University of California has a new atom smasher which was un at Berkeley on April 23. The machine is designed especially to ac te nuclei, or ions, of very heavy — it is therefore called a "heavy ccelerator", or "Hilac". Its cost approximately 1,700,000 dollars will be used to synthesise atoms r than element 101. It is now rating nuclei of hydrogen atoms to es of 140-million electron volts. top picture shows the interior of om smasher. Heavy fragments of r are hurled through the dough-aped drift tubes that extend the of the atom gun's barrel. The arrow) at the end of the big bar-ost-stripper) highlights its size — ng and 10ft in diameter.

right are seen Dr. Ernest Lawrence ntor of the Lawrence TV color Dr. Glen Seaborg and Dr. Albert rso standing by the target of the machine. Dr. Lawrence is Pro- of Physics at the University of rnia.



Iron Dust Makes Super Magnets

Developments in materials for the construction of magnets have been a major achievement of recent years. Permanent magnets are now used in places where once powerful electro-magnets were required, and still more recently scientists and engineers have learned how to make magnets from plastic materials. This article mentions some of the latest developments in this field.

FEATHERY particles of iron, too small to be seen with ordinary microscopes, promise the most powerful permanent magnets ever made.

Embedded in plastic, metal, glass or rubber, the specially prepared iron dust yields magnets that are easily fashioned into any desired shape.

Announcing this new way to make magnets, the General Electric Company calls it a major scientific breakthrough.

Smaller, lighter, more accurate and rugged electric devices will result. Light exposure meters, aircraft instruments, countless other magnet-using appliances.

It will be some time before the iron-dust magnets are commercially available in quantity. But experimental ones have proved as powerful, in proportion to size, as today's best commercial magnets and it is believed that they can be made 10 times stronger.

Tiny iron particles are made by GE by electroplating them from solution of iron compound into tank of liquid metal, such as mercury, which forms cathode. They float to surface and can be gathered by hand with a magnet (left).

New magnets of varied design surround plateful of iron-dust material. It looks black because of particles' fineness. A pound contains more than a billion billion of them.

More has been learned about magnets' basic structure in the last 10 years than in the previous 20 centuries. In our schooldays, we were taught that ordinary soft iron was fine for electromagnets, but no good for permanent magnets since, as everyone knew, a solid chunk of iron wouldn't stay magnetized. So old-fashioned "horseshoe" permanent magnets were of tungsten or chromium steel; more modern ones are of Alnico, an aluminium-nickel-copper alloy.

"Fine-particle" permanent magnets are the latest advance. By using a magnetic material in small particles rather than in solid form, they have upset former rules and turned some of the least likely materials into the best. Powerful enough to rate as "supermagnets" are three principal kinds:

Westinghouse has recently announced supermagnets of manganese bismuth, a powdered compound of these two metals embedded in plastic.

Barium ferrite, a readily molded ceramic compound of barium and iron oxides, has been developed abroad and introduced here for supermagnets.

Now come the supermagnets of pure-iron particles. According to theory, it is maintained, their maximum possible strength far outranks that of the others. And it can be boosted even a little further by using an iron-cobalt combination of particles. However, the iron-only magnets have the big advantage of requiring no strategic materials.

Ornamental magnet (left) of iron dust embedded in lead contrasts with conventional (right) and offers examples of novel shapes and materials possible. Patterns below, made by common iron filings on paper placed over these magnets to compare their magnetic fields.

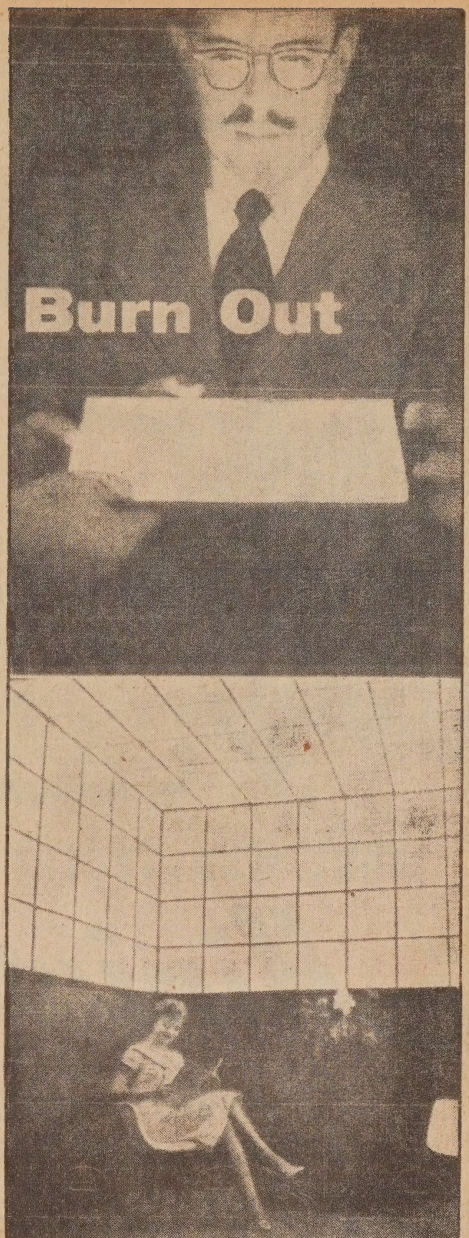
revolutionary new kind of electric light
here. It won't break, and it won't burn
t. It glows as a bright surface, not as a
e the way fluorescent lights do, nor as a
oint the way incandescent bulbs do.

The Light That Won't Burn Out

S is electronic light. It promises rooms illuminated by
alls or ceilings that glow all over—and whose color you
hange to suit your mood. The lamps would be actual
of the room, like present-day acoustical tiles.
hat's for tomorow. But electronic light is already in
ercial use today.
ut they don't look anything like lamps. They look like
hacksawed off a kitchen stove. They're thin steel,
orcelain on one side. You can throw one around a table,
ang it hard against the table edge. No harm done. Plug
wires and the porcelain side emits light.
his is a condenser, actually, a direct descendant of the
n jar that Ben Franklin used. It is basically like the
nsers in every radio and television receiver. There are
lates, to which the electrical terminals are attached, and
ween the plates is a dielectric material to help store elec-
energy.
low, ordinary condensers never light up. The difference
s the dielectric material, which contains a phosphor, a
cal that will emit light when you tickle it the right
In this case the tickle comes from the electric field be-
the condenser plates. One of the plates is transparent,
t the light can get out.
n the electronic lamps now on the market, the steel
one plate of the condenser. The other, transparent, plate
hin film of tin oxide, which conducts electricity. The
tric in between is ordinary porcelain, but it contains
ulphide phosphor.

ER ADVANTAGES

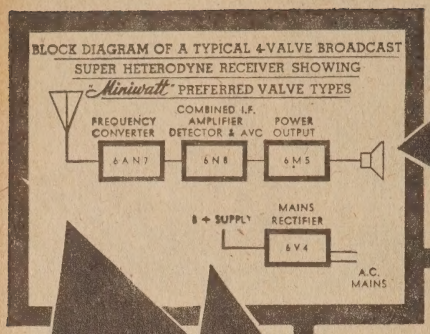
turdiness that no one ever thought a lamp could have
one advantage. Among the other advantages:
hape. Usually you want to light a surface—such as
top—but must start with a line or point source of light.
lectronic lamp already is a surface, so you don't need
sive fixtures to spread its light pattern.
ife. Some electronic lamps have been left on con-
sly since 1951. They still deliver light. There are
aments or cathodes to burn out, and these lamps never
ut the way that other lights do. As time goes by, their
output decreases gradually, perhaps by as much as half
10 years.
Color. Different materials make electronic lamps of
nt colors. But you can also change the color of the
rom a single lamp by just changing the frequency of its
ower supply. This suggests a color-control knob for the
onically lit room. In hot weather you adjust the fre-
y so that your luminous ceiling glows a cool green;
ld, gloomy weather you flood the room with warm
ish light.
here is a catch to all this, however. Electronic lamps are
rful, but the glowing ceiling is not very practical right
There are two basic difficulties that only research can
me:
rightness is one. The Sylvania lamps on the market are
vel lights, bright enough for dials and signs. But no-
now, would use any of these lamps to read by.
he other difficulty is with efficiency. The best electronic
that Westinghouse has made needs twice as much elec-
per unit of light output as even an incandescent lamp
seven or eight times as much as a fluorescent.
he future is very promising on this score, however.
descent and flourescent lights are now nearly as efficient
y can ever be. Electronic lamps can be tremendously
nt. Theoretically they could be 2½ times better than
scents, more than 10 times better than incandescents.
igher brightness is the big problem, because that's what



Glowing panel held by Dr. H. F. Ivey (top) is sample of the 112 lights in Westinghouse experimental room (below). These are glass; Sylvania's commercial lamps are porcelainised steel.

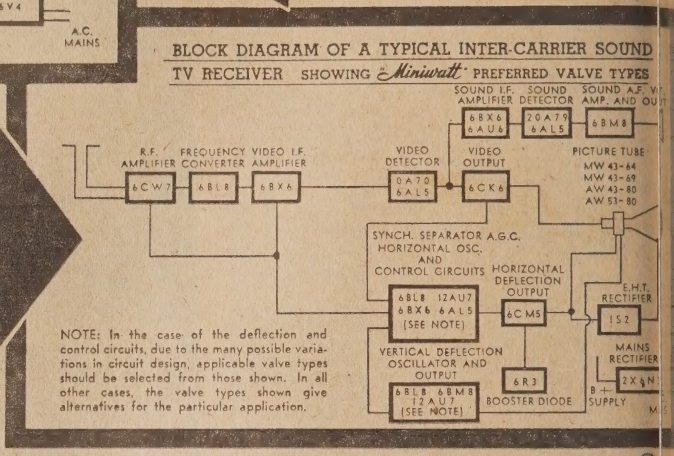
room illumination needs. You can make electronic lamps bright by operating them at high voltage or high frequency or both.

Westinghouse showed off recently a mock-up room that was as brightly lit as you would want. It had 112 electronic lamp panels covering the ceiling and most of the walls. But the power supply was 350 volts, 3000 cycles. That's not what you want around your house. So the hunt is on for phosphors and dielectric materials that will deliver more light with a reasonable power supply.



For simple A.M. circuits

or complex T.V. circuits



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it works? You can see why voltage and frequency increase ess if you look inside an elec- lamp. Since it is a condenser, it es a field of electric force be- its two plates. Every time the changes (alternating current) it oose electrons from the edges of osphor crystals. These electrons into the phosphor crystals, bang toms and transfer their energy atoms. The atoms release this acquired energy in the form of

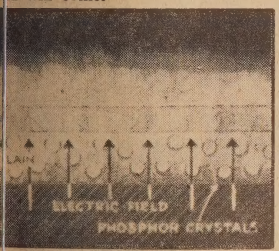
ier voltages make more powerful So less-willing electrons get kick- se. Higher frequencies mean the come more often, increasing the unity for electrons to be freed.

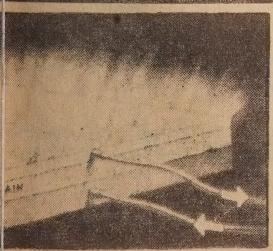
phenomenon of electronic light by a varying field has a seven scientific name: electrolumines- Credit for its discovery goes to a scientist, Georges Destriau. In e built a crude electronic lamp ngredient was sea water), noticed glimmer, and published his re- n a scientific journal.

ania's researchers built a few us condensers—weak ones, just in a dark room. But within a ars, they had increased the light nearly 1000 times, and produc- gan.

ania has now sold about 200,000 nic lamps — strictly on the basis hey do a particular illumination tter and cheaper than any other ource can. Besides the clock and dials, you should soon see elec- lly lit telephone and thermometer witch plates, night lights and aero- fasten-your-seatbelt signs.

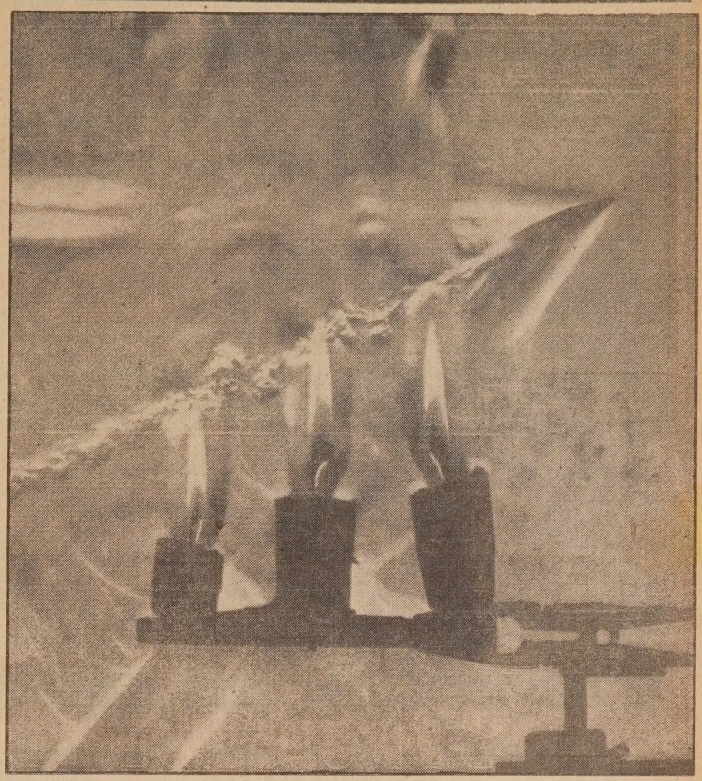
n can you expect the brighter, efficient room lamps that will luminous ceilings and walls? Two perhaps five years. The experts hat a major breakthrough is need- d will come.





roluminescence. This lamp is a enser — one plate is steel, the transparent film. Electric field een plates frees electrons in phos- porcelain mixture, shooting them phosphor crystals. These freed rons strike phosphor atoms, which emit light.

BULLET SHOWS UP SHOCK WAVE



This photo of a bullet passing through the flames of three candles is a visual demonstration of supersonic missiles breaking through the sound barrier. Using the "schlieren" method, Prof. Hubert Schardin of Germany photographed it at 1/10,000,000 of a second. Above the candles, the shock wave of the projectile is refracted in the heated air.

NEW PLASTIC MATERIAL MAY RIVAL METAL

The discovery and initial development of a new plastic material tough enough to replace metals in many applications has been developed. Parts made from the new compound, a polycarbonate resin, are reportedly strong enough to withstand the blows of a carpenter's hammer. The moulding compound is expected to replace cast metals, ceramics and other plastics in some applications.

THE new resin offers an unusual combination of toughness, impact strength, heat resistance and dimensional stability. These properties make it promising for applications not previously handled by conventional thermoplastic materials.

The polymer is now being evaulated in the form of moulding compound, extrusion compound, film, varnish and coatings.

Favorable results from some or all of these evaluations, coupled with current process studies, will provide the information needed to make a decision on supplying the market with commercial quantities.

Until the present evaluations have been completed, samples will not be available for general distribution.

Early studies indicate that the resin can be made in a variety of transparent or opaque colors, with parts showing good surface hardness and gloss. Properties of the polymer suggest its use in such applications as coil forms, decorative and functional appliance parts, gears, automotive parts, housings, structural parts, handles, drawer rollers, electronic components, and telephone accessories.

The excellent electrical characteristics, high thermal stability, low water absorption, and high tensile strength of polycarbonate film make it suitable for use as an electrical insulating material.

The original polycarbonate chemistry on which present polymers are based grew out of General Electric's continuing research efforts directed at new, improved insulating materials. The affinity between electrical and chemical research has been demonstrated in many previous discoveries in the chemical field.

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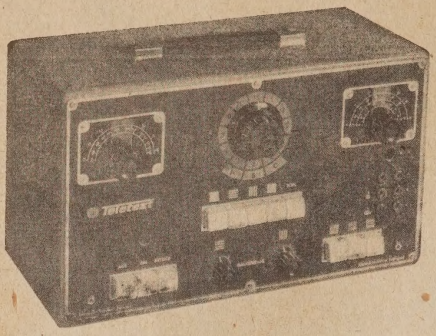
MODEL FS4A



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EQUIPMENT FOR INDUSTRY AND RESEARCH

ANT TRANSISTOR FOR 40 AMPS

icle was written for us by Dr. Fletcher, research worker for IRO, who was responsible for sign of the high power trans- scribed here. Several accounts work have appeared in the dings of the IRE in America, ave aroused great interest overseas.

transistor is familiar to ost of us as a very low device used in hearing small portable radios, and During the past few years, er, there has been consid- development work done nsistors to handle higher ers, and the CSIRO o p h y sics Laboratory in y has recently described a stor which they have de- d to handle k i l o w a t t .

ary small transistors consist of a e of germanium with a small dot m on one side (the collector) and other side a smaller indium dot itter), and a nickel base tab. For owers (a few watts at currents up mp. or so), the dots are made and the base connection is made rm of a ring around the emitter.

me applications there has been or transistors to switch very high at voltages up to 30 V. or so, s pulse modulators in radar type or as square wave generators, gulators, etc.

ese high currents, some tens of s, a still larger version of the power transistor becomes very nt, due to the base current which flow out from all parts of the to the base lead.

STRUCTURE

vercome this trouble a new tran- tructure was designed. In the nsistor the emitter is in the form ng thin bar, and the base con- is made by a long thin bar on ide of it. For convenience these ay be bent into the shape of This has been done with the pre- nsistor, which is a disc a little than a threepence, with two emit- two base rings.

transistor described is able to currents up to 40 amperes, with a gain of about 15, so that operat- 0 volts, pulse powers of about a t can be obtained.

ency response is limited for a de- his type, but rise times less than second have been measured.

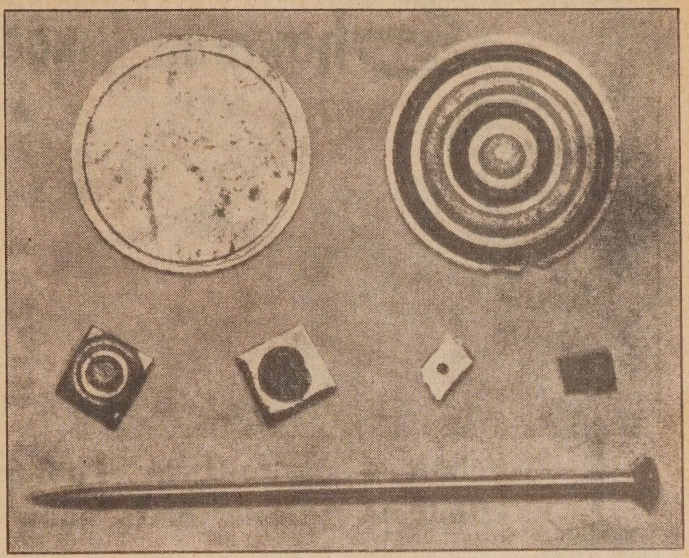


FIGURE 1. Active element of the kilowatt transistor — emitter rings show up grey, base rings black; the collector covers almost all the back surface. Shown also are the basic elements of an ordinary power transistor and of a hearing aid transistor. The pin gives an idea of size.

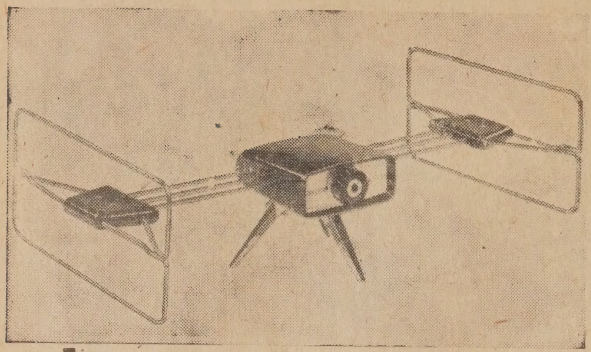
The average power output which can be obtained from a transistor depends, apart from its peak rating, upon the efficiency with which heat can be removed. High dissipation transistors, therefore need efficient connection fins, or even water cooling. The present transistor was intended for use in a radar-type modulation circuit, with a very short duty cycle, so that average dissipation was only a few watts.

Several American firms are now experimenting with high power transistors, based on this design, principally for use in high power DC convertors, voltage regulators and other nigh current control circuits. Because of their high efficiency, transistors are ideal for use in these cases, and together with the more familiar high current germanium and silicon diodes are already revolutionising high current DC supply systems.

FIGURE 2. A partially assembled and a completed kilowatt pulse transistor. A conventional hearing aid type of transistor is shown for comparison.

CHANNEL MASTER

"Showman" INDOOR TV AERIA



A Beautiful Job . . .
in appearance an
electronically

Different from any other In Aerial.

This is the aerial you'll be proud t on top of that TV set. The "Show is a little gem that excites the in of your friends and brings you in s reception. Only £15/10/- retail ar installation charges, or difficulties.

Fabulous Metro-Dyne Tuning is the answer eliminate "ghosts" and "snow" in many locati

Ordinary switch-type aerials work by connecting various parts of the into different combinations. METRO-DYNE tuning on the other hand i able inductance" tuning. It is the first system on the market (inc outdoor) in which a broad band aerial can be tuned to a specific cha that it exhibits the band width characteristics of a single-channel yagi selectivity cuts down tremendously on "electronic noise" and interf The system also incorporates an auto-transformer to maintain a const ohm match on all channels.

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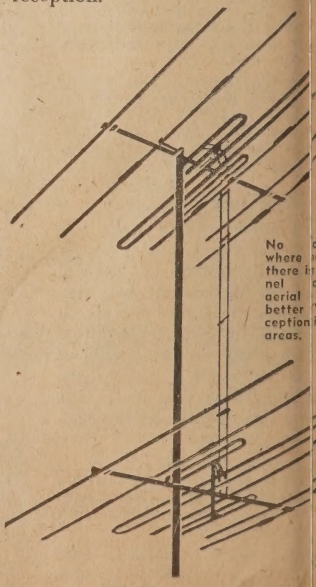


No where there it nel aerial better ception areas.

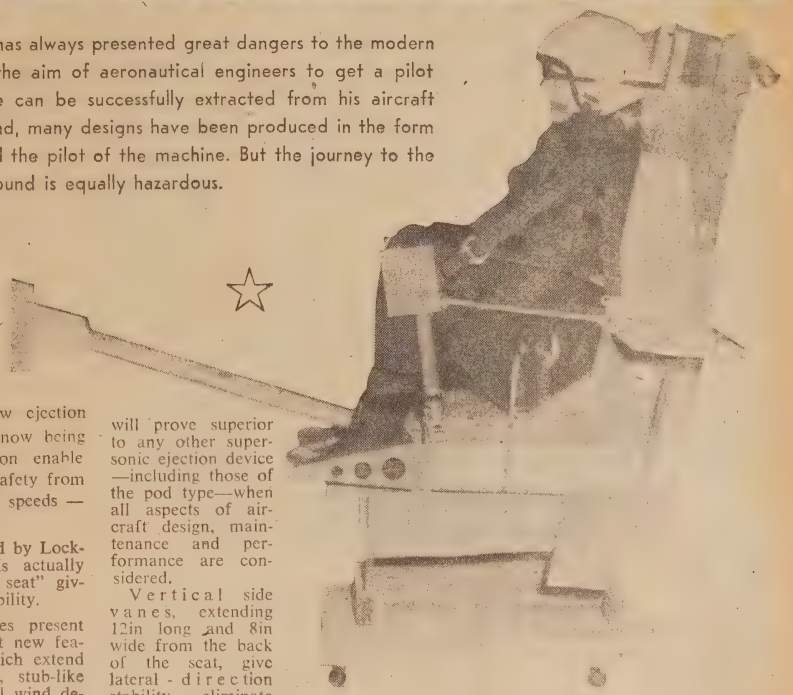
Channel Master Pty. Ltd. (Inc. in Victoria) 752 Pittwater Road, Brookvale, N.S.W. XW0221.

N.S.W. Distributors:—Ferris Bros. Pty. Ltd., East Sydney. FA6643.

Vic. Distributors:—Warburton Franki (Melb.) Ltd., 380 Bourke Street. MU9726.

EJECTOR SEAT HAS OWN WINGS

ng out at high speeds has always presented great dangers to the modern y. It has always been the aim of aeronautical engineers to get a pilot ly to the ground if he can be successfully extracted from his aircraft n emergency. To this end, many designs have been produced in the form jection seats, to propel the pilot of the machine. But the journey to the ground is equally hazardous.



— The new or seat showthe stubby upon which pilot "flies" to

REVOLUTIONARY new ejection at for combat aircraft now being d in America, may soon enable to bale out in perfect safety from s travelling at supersonic speeds — 00 mph and more.

is latest model, developed by Lock- Aircraft Corporation is actually rachute-equipped "flying seat" giv- omplete aerodynamic stability.

appearance, it resembles present ghter ejection seats. But new fea- include vertical fins which extend ; each side of its back, stub-like s, and a waffle-sized steel wind de- r. This key feature is a 4ft-long in front to give the occupant pro- m against windblast.

T WILL FLY

bale out, a crew member has only ull up on a D-shaped ring located een his feet. A catapult ejects the which will then "fly" completely — until a parachute attached to eat, opens automatically at a pre- mined altitude and airspeed. After arachute opens the seat separates falls free.

ith a conventional ejection seat fliers l be subjected to 50 times the pull ravity in a 1500 mph bale-out at 0 feet — plus hazardous tumbling ts.

t Lockheed engineers predict that the new device, jet crew members be able to bale out safely at strato- ic heights and up to twice the l of sound — or even as low as at 850 mph.

ll-scale model tests are proceeding ssfully at the US Air Force's Super- Military Air Research Track. In of these tests the seat is ejected the rim of a precipice at ultra- speeds by a rocket-propelled sled.

e new ejection seats, weighing only ounds more than current types in can be adopted to fit into most Air e jet fighters, interceptors or bers.

ckheed believes this escape system will prove superior to any other supersonic ejection device —including those of the pod type—when all aspects of aircraft design, maintenance and performance are considered.

Vertical side vanes, extending 12in long and 8in wide from the back of the seat, give lateral-direction stability, eliminate pitch and roll effects, and enable the occupant to be always facing forward after a bailout.

The D-ring, tripping a cartridge with a one-second timing delay, sets off the seat's explosive-charge catapult. During the one-second delay, before the catapult ejects the seat along guide rails, the following pilot safety devices are activated:

- knee guards snap into position to prevent leg spreading and to counteract the effects of outward airloads
- arm-support webbing flips up to prevent outward movement of arms while allowing airloads to offset inertia forces
- metal stirrups pull the feet close to the body and hold them securely until time of man-seat separation
- lateral head supports clamp against the side of the helmet to relieve neck loads.

AUTOMATIC OPENING

Prior to flight, the crew member connects himself to the seat-attached parachute by means of a specially designed harness. Packaging the parachute in the seat gives the crew member greater freedom of movement in the cockpit and relieves him of wearing a cumbersome pack during pre-flight activities on the ground.

Parachute deployment normally occurs when the indicated airspeed is less than 300 knots and the altitude is below 15,000ft. A combination barometer and airspeed indicator attached to the parachute, automatically controls its opening. The new seat incorporates oxygen and communications equipment specially designed to withstand supersonic airblast.

BI-LINGUAL TV SYSTEM

BI-LINGUAL television transmission, with two different sound accompaniments to the picture, may be a desirable thing for some countries. A method of achieving this technically, devised by the French firm, Radio-Technique has been reported by the European Broadcasting Union.

The two audio signals are arranged to amplitude modulate two interlaced trains of pulses transmitted in the normal sound channel—on the time division multiplex principle. The time spacing of the pulses in each train is equal to the duration of a line scan, and the trains are phase locked to the line synch pulses.

At the receiving end the method of separation is to apply a gating signal to one end of the sound channel IF valves in such a way that only the pulses carrying the wanted sound accompaniment are allowed through.

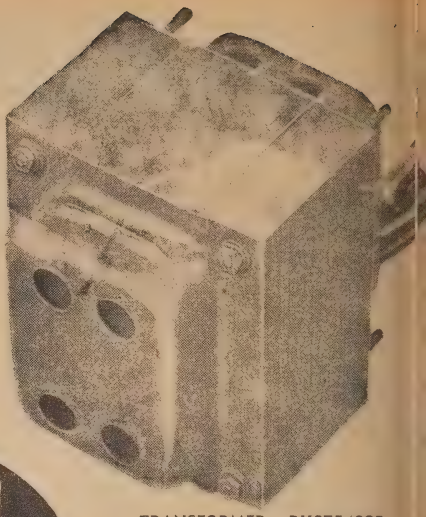
It is claimed that a very simple and inexpensive "decoder" unit, using no valves, is all that is required to change an ordinary television set into a "bi-lingual" receiver.

For

"Radio Television & Hobbies"

17" TV RECEIVER

specify—



National

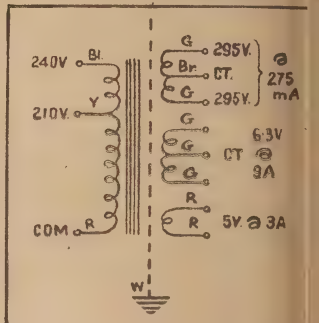
POWER TV TRANSFORMER

RH275/295

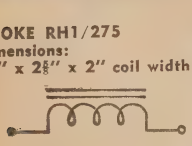
for these 8 reasons—

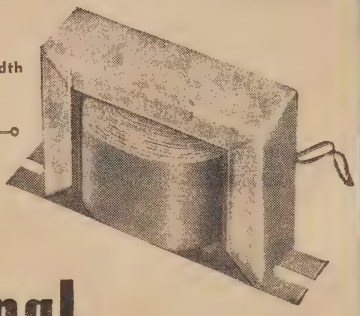
TRANSFORMER RH275/295

Dimensions (upright mounting)
4½in x 3¾in, chassis height 4¼in.



CHOKE RH1/275
Dimensions:
3½" x 2⅝" x 2" coil width





Specify

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RH1/275 TV CHOKE

for the same Receiver

- Inductance—1 Henry.
- Current Rating—275mA.
- Fitted with easy mount clamps.

Contact your usual supplier for full details . . . NOW

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PRODUCTION FACILITIES

1. NATIONAL is the largest T.V transformer manufacturer in th Commonwealth with a modern mass production factory capabl of supplying the full require ments of T.V. Quality control ensure uniformity of productio in each particular line NATIONAL'S experience and specialised development bene fit Manufacturers.

TECHNICAL FEATURES

2. Designed to operate at low flu density thus reducing interferenc in picture tube.
3. Electrostatic shield betwee primary and secondary minimis line pick-up.
4. Fitted with copper strapping t reduce external field.
5. "Rolled-edge" holes in cov prevent chafing of leads.
6. Unique lead-anchoring inside th core prevents leads being pulle out.
7. Air-cooled scientifically. Louvr and vents in the cover provi maximum cooling.
8. Low temperature rise reduces th ambient of the T.V. receiv chassis.

DEVICE DETECTS IO-ACTIVE TAMINATION 5 SECONDS

easuring and recording nu- ar radiation and answering important questions in 15 onds on radioactive con- ination is the job being ie by a new electronic device eloped by General Electric mpany engineers at the Hanford atomic plant.

instrument electronically scans hands and shoes of workers, out tiny bits of radioactive con- tion which may have been acci y brought out of adjacent radia ork areas. It detects alpha, beta mma radiation as against previous which spotted either alpha radia- one or beta and gamma radiation ed.

12 questions it answers regard f radiation from specific areas of and shoes. Six circuits are geared up evidence of beta-gamma radia- n six areas of hands and shoes. the remaining six detect telltale radiation from the same area.

NING LIGHTS

minute bit of radioactive material overed the machine flashes a red g light marked, for example, left palm" of "beta-gamma left Once discovered, the contamina- n be safely removed.

en lights flashing on at the end of unting period indicate there is no ctivity above the preset or "back- l" sensitivity levels of the instru-

"brainpower" of the new detection nent was increased by using scin- n probes for detecting alpha radia- nd Geiger-Muller tubes for reveal- e presence of beta and gamma Both detection systems are com- in the same probes.

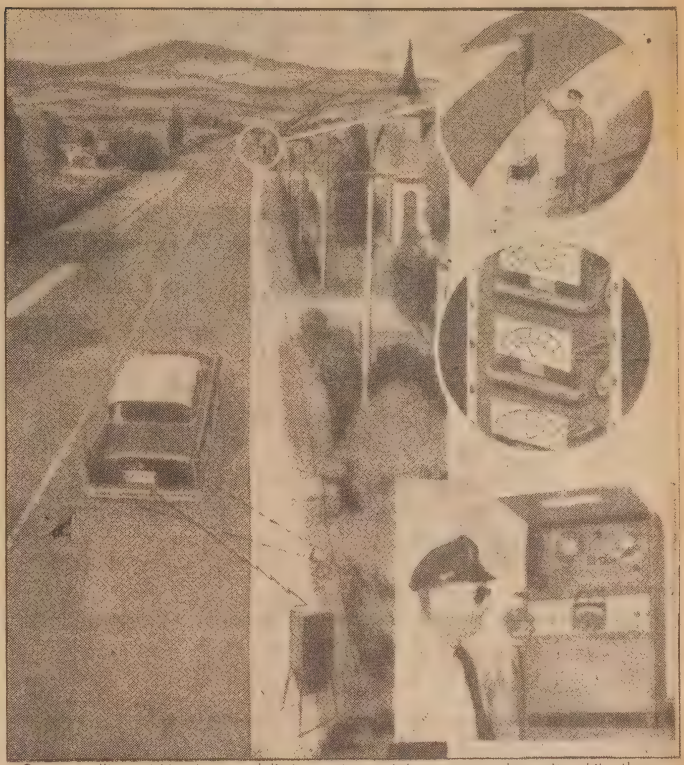
scintillation portions of the probes te sulphide powder as the scintilla- osphor and when alpha particles strike the powder they create tiny flashes of light. Multiplier photo-tubes pick up the faint light flashes and send electrical current in proportion to the strength of the flashes to the signal lights.

The beta-gamma warning lights on the outside panel light up when activated by current created when beta or gamma rays cause ionisation in glasswall Geiger-Mueller tubes.

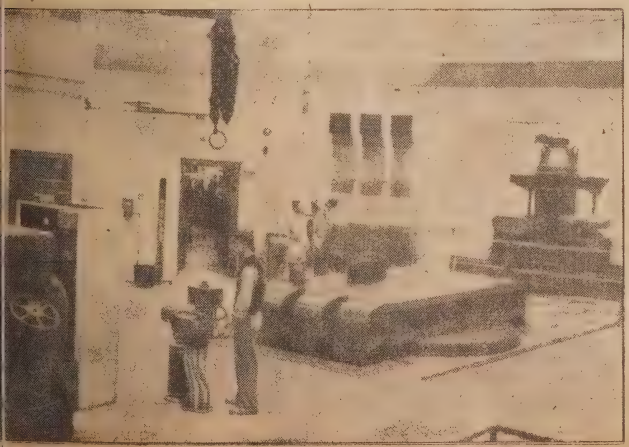
If no radiation is detected which would activate the warning lights a network of relays turns on the 12 green "safe" lights.

The new instrument's intelligence quotient is nearly matched by its economical feasibility. When placed in production the new instrument will combine into one operation the two steps reuired of old "four-fold" instruments, the hand and shoe count mainstay of the past decade.

RADAR UNIT SELECTS SPEED VIOLATORS



Cars travelling within the speed limit are ignored by a new radar unit, while those exceeding the limit are instantly spotted. The radar meter, built by Admiral, can be preset for the prevailing speed limit. It then registers only the cars that break the law. An optional attachment will take a picture of the licence number of the violator's car along with the speed reading. Floodlights can be synchronized to operate automatically with the meter at night. Another optional attachment is a tape recorder which permits a traffic officer to read a car's speed and licence number.



Left. A general view of the first nuclear power system in the USA designed specifically for experiments in producing power. It is at the Argonne National Laboratory near Chicago, and will supply 5,000Kw of continuous power. The engineer in the foreground is at the controls of one of the turbine generators in the foreground. The steel beamed top of the reactor is in the centre of the picture, while fuel handling equipment and fuel storage well are in the background.

This is the WORLD'S FINEST MAGNETIC RECORDING TAPE

EMITAPE

As used by the leading Broadcasting Organisations and for the recordings by:

"HIS MASTER'S VOICE,"
COLUMBIA AND
PARLOPHONE

EMITAPE "88"
General-purpose tape available on spool sizes from 3" to 7" diameter.

EMITAPE "99"
Long play—thin-based tape, giving 50% increased recording time on same spool range.

EMITAPE uses P.V.C. (polyvinyl-chloride) high-tensile film base — the film base which has streng plus stability under varying temperature and humidity conditions.

EMITAPE has a specially developed magnetic oxide coating of high sensitivity with an electric specification designed to achieve the maximum performance from all tape recorders, all speeds, sing or twin track.

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V CAMERAS
or SURGICAL
OLOR CASTS

nochrome TV has already en widely used in medical les and for various industrial poses. Now the Radio rporation of America has ted commercial production he first compatible color tele- on camera system specific- desgned for medical use.

INEERED for completely remote peration and maximum operating ny, the medical TV camera is ed to be widely used in hospitals nedical centres, colleges and uni- es, and research institutions for ation of live closed-circuit or on- olorcasts of surgical, medical and ional instruction and demon- ns.

t units have been shipped to r Reed Army Medical Centre, . Kline and French Laboratories, ne University of Michigan Medical l.

e medical camera is designed d three vidicon camera tubes and l circuitry which make possible sing surgical procedures in full- detail under normal operating- lighting.

e unit is designed to permit long ls of exposure to a single scene ut danger of image burn-in, and to iate halo or over-loading effects d by reflections from polished in- ents or wet tissue.

IZONTAL MOUNTING

e camera's "overhead" design keeps of interference range of the sur- or instructor, yet permits un- cted viewing freedom.

rizontally mounted, the camera into a mirror which reflects the l path downward through an open- the surgical lamp.

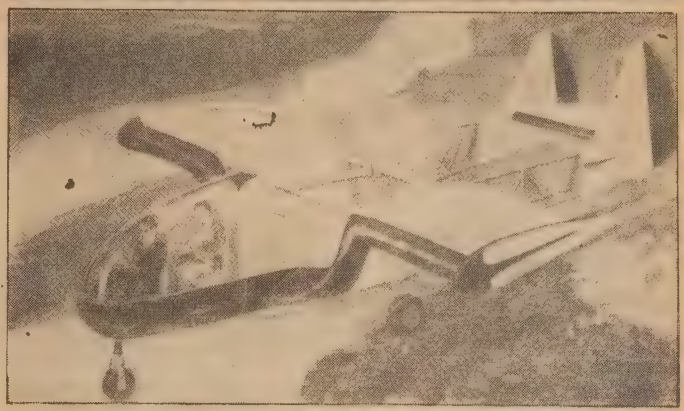
notely controlled, the mirror can nned and tilted to change the view- ield without moving camera or

the lamp is moved, the camera's l path automatically moves to ide with the change in lighting path. e camera's complete remote-control n permits one-man operation of the system, including camera focusing ens selections, as well as operation e camera mirror.

cases of surgery confined to a tiny such as the eye, optical magnific- of the televised area can be ob- d by selection of lenses with long al focus.

e camera can also be used with a oscope system.

NEW PLANE TO LAND AT 5 mph



Composite picture shows how the proposed aircraft will appear in flight.

BLENDING of auto and aircraft are merely a step away, if tests succeed on a plane with a single-channel wing that has outboard panels working like ailerons.

By mid-1957 experiments will have pin-pointed whether this prototype can take off and land at five miles per hour inside its own length of 18 feet.

One trial involves the clearing of a 50ft obstacle within 300 feet of a standing start and at a climb rate of 4000 feet per minute.

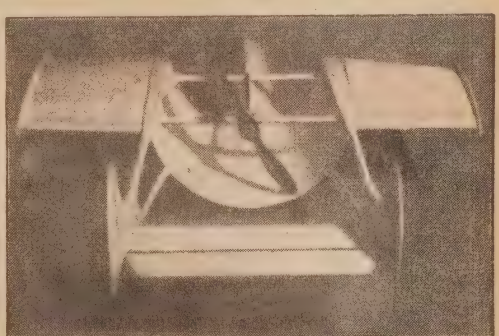
Carrying two passengers and powered by a 240-horsepower engine, the craft is expected to fly 200 miles per hour at a range of 1200 miles. The plane operates on a principle developed by Willard R. Custer. Lift and thrust are produced by drawing air at tremendous speeds through the channel wing.

Pending test outcome, designers plan a craft that will land on a road, folding its wings to width of less than eight feet and disengaging the propeller shaft to become an automobile, all without halting.

☆

Model shows cross section of the specially designed channel wing which gives high degree of lift.

☆



PELTIER EFFECT FOR COOLING TRANSISTORS

COLD, or the removal of heat, becomes increasingly important in electronics. Cooling equipment packages is accomplished in several ways, one being the use of transistors in place of electron tubes. However, even the transistorised device must be operated at temperatures below the ambient and the weight of cooling equipment often far exceeds that of the semi-conductors.

According to the annual report of NYU's College of Engineering, use of the Peltier effect is being investigated for cooling transistor packages. This effect employs junctions of dissimilar metals to produce a temperature drop when current is passed in the proper direction.

Among semiconductor alloys whose thermal conductivity, electrical resistivity and thermoelectric power were measured in the last year, the most promising were those containing tellurium. The goal is to cut down cooling requirements sufficient to permit power transistor units up to 100 watts to be used in mobile units.

There are no limits to the field o research. These Australian workers slicing sections of wood into thin sl so that their cellular structure ca be checked under a microscope. Th slicer, seen in the background, cu 1/50th of a millimetre.

Research Must Have Metho

To obtain the maximum result with a minimum of effort, research projects must be plann and executed in an orderly manner. In this article, our contributor who has himself shar in such projects, gives an idea of how the research worker goes about his proble

by Calvin Walters

NOT many people outside the normal staff of a research laboratory fully understand just how much detail goes into the solving of the many problems with which the laboratory has to deal.

It is not a matter of hit-and-miss methods and haphazard experiment.

From the time that a problem is stated every step must be thought out in advance so that the desired result will be obtained with the minimum wastage of time, effort and materials.

BASIS OF THOUGHT

It is proposed in this article to detail some of the methods adopted by research workers in the solution of problems. It is clearly impossible in such a short space to be as fully comprehensive as desired, and there will be many missing links. However, I will attempt to make clear to my readers just what goes on in a research laboratory so that they may have a better appreciation of the work of the research scientist.

Modern science is founded on three main bases, namely speculative thinking, deductive reasoning and experimentation.

In order that time will not be wasted on the solving of useless problems it first must be considered whether experiment on a certain matter is worthwhile. One must decide first whether an observed phenomenon has any significance, whether the solution to the problem will lead to anything of value and whether the solution will be utilised.

For instance, if a farmer were to find a blue-skinned orange growing on one of his trees he would most likely send it to the Department of Agriculture for an explanation. He would naturally think that if he could grow blue-skinned oranges he would make a fortune in some way or other.

Now the laboratories of the Department of Agriculture would look at the orange and first of all open it up. If they found that the quality of the orange inside was just the same as that other orange, they would most pr consider that it would be a wa time and effort to carry out lengt periments just to find out why it blue skin, unless some reasoning ed it to be the result of some or other factor which could be det tal to the orange orchardist.

SIMPLE EXAMPLE

If, on the other hand, the inside orange showed some remarkable teristic such as an extraordinary a great preponderance of juice ove and so on, then they would mo tainly investigate the problem view to cultivating a new kind of

If the only characteristic of the skinned orange was that of being less, this would not warrant furth vestigation, for even if it was p to create a blue-skinned, seedless it would be no better than the skinned seedless oranges already It is therefore essential that the s of any problem must have a purpo be of some use.

The work of planning the attac problem usually falls on the Re Director, whose job it is to see problem is properly stated at the

Sometimes much waste accru cause the problem is not properly This could be brought about becau observation which brought it abo faulty in the first place.

A statement of the problem, ca thought out, will often bring to whether it is of any importan whether it will be of use when Thus, if the problem is stated in different ways, to redefine it and f limits, the reasoning which follow often lead the way to a solution.

BACKGROUND SEARCH

It is important that the research ers be informed of how the pr arose, why it has any significanc what is intended to be done wi results.

After the problem has been the next step is to search all the ture available on the subject rela the problem. This will often give to the method to be adopted. P someone else has observed a phenomenon in the past, given a

t and experiment to it, got cer-
sults, then gave it away for some
He may have published cer-
nclusions which will be of use.
etimes a problem will be of more
iance than it was years ago. Per-
t was significant years ago, but
k of proper equipment made the
gation impossible. An example
is the field of microwave spec-
oy. This has always been an at-
n but it could not be fully inves-
until the invention of the magne-
nd klystron oscillators.
a great deal of useful informa-
ay have been gleaned by a com-
isive, systematic search of litera-
ut whether this is so or not, the
gator must now begin to formu-
working hypothesis based more or
n his knowledge of the matter in

working hypothesis is a trial idea
nporary suggestion concerning the
of the matter.

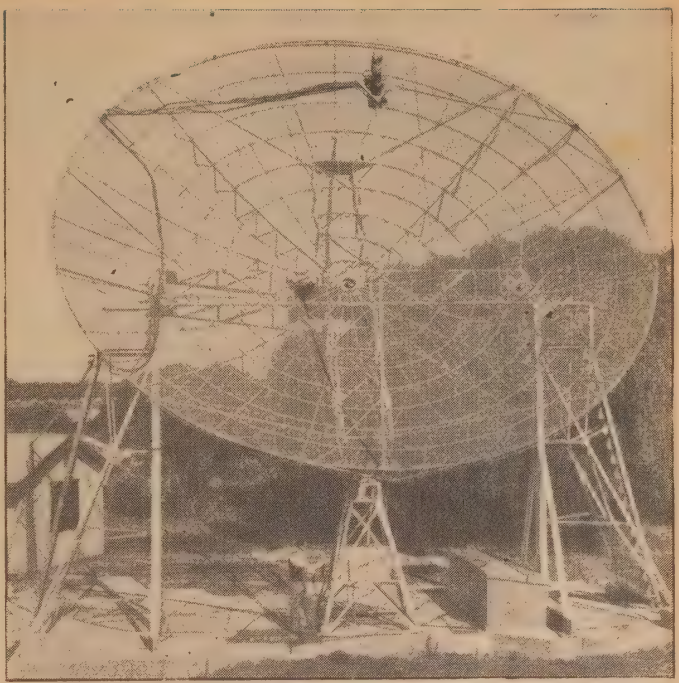
NG THE FACTS

usual to try and formulate a hypo-
which will fit the facts as ob-
It may be that several hypo-
will be formulated. These will
ought out carefully in turn, until
flaw is found and it is then re-
If two hypotheses fit the ob-
facts but one is simpler than the
the simpler is the one to use as
is of experiment.
er the hypothesis has been formu-
the next process is the use of deduc-
easoning based on the rules of for-
ogic. It is only when the hypo-
has been formulated that logic can
ed in any scientific problem.
e the investigator has reached this
of the problem the application of
l logic and deductive reasoning
ead him step by step to the solu-
of the problem. It sometimes
s the hypothesis so simple that the
quences become obvious.
simple example of a problem, a
hesis, deductive reasoning and the
on can be the following.
ar car engine stops Problem
s up?
w if you are mechanically minded
know how the car functions, you
bout the construction of working
heses until you find one which fits
icts. You may have to formulate
l hypotheses and test each one in

ING HYPOTHESES

e car may have displayed certain
oms before it stopped. These
oms may be common to several
s, any one of which could be the
le. There may have been a back-
nto the carburettor. This could
used by too weak a mixture. This
in turn be caused by dirt in the
lack of petrol. The latter could
used by there being no petrol in
ink or an obstruction in the petrol

the car just stopped without any
ular symptoms you formulate hypo-
s based on (1) fuel trouble, (2) elec-
trouble, (3) mechanical trouble or
nbination of all these. You test



Australians have achieved world fame with their radio telescopes, and are planning a half-million pound project for early construction. This one, the aerial of which is erected at Potts Hill, has been in action for three years, tracking invisible stars by their emitted radio waves.

each hypothesis in turn, using deductive reasoning as to what would be the consequences of a certain thing happening

This man is not making mud pies. He is checking a local water supply to test a new technique in eliminating liver-fluke in sheep and cattle.

or of something you intend to do to test your hypothesis. In this way you systematically go through the various points until you finally reach the cause of the trouble, your hypothesis has been proved and the problem solved.

The testing of hypotheses often requires a search into causes based on the knowledge of effects. One of the most important principles used is called the "method of agreement" which states that if there is a common factor in the circumstances leading up to a certain event, that factor may be the cause which is sought.

This is not always proof of cause because there may be another disguised factor which was also common to the circumstances. There may be two factors which are common.

FALLACY

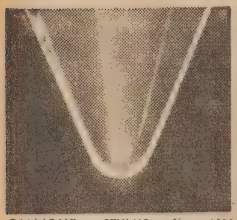
There is a story told about a Scotsman who always felt pretty bad the morning following parties when he imbibed too much whisky and soda. So he changed over to brandy and soda at the next party but still felt pretty bad. He then changed to rum and soda and things were no better. He therefore concluded that as the soda was common to all drinks it must be the cause of the trouble and he decided to omit the soda from all future drinks.

Another method is the "Method of Difference". This states that if two sets of circumstances differ in only one fac-

Goldring micro Diamond

DIAMOND STYLI

NEW LOW-MASS TYPE ACCLAIMED BY OVERSEAS "HI-FI" ENTHUSIASTS

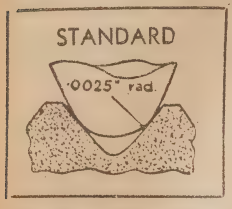


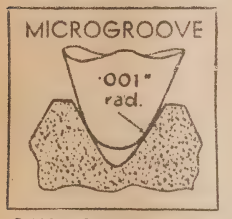
DIAMOND STYLUS after 1000 PLAYINGS. Micro-photograph shows entire absence of wear and perfect contour after 1000 playings on "78" shellac discs.

- ★ **Small size reduces mass to the minimum.**
- ★ **Brilliance of polish reduces surface noise and reduces record**
- ★ **Unsurpassed quality makes Goldring Micro-Diamonds sought by world's leading high-fidelity specialists, and the most econo form of stylus.**
- ★ **Up to 40 times the playing life of sapphire styli.**
- ★ **Shaped and polished by hand from genuine natural diamonds exact dimensions essential for perfect reproduction!**

Now, with the sensational Goldring Micro Diamond Stylus, you can bet production all the time. No danger of accidental chipping—the g diamond point is the hardest substance known. The polished Goldrin Point" glides through the grooves, with perfect compliance and fricti non-wearing, noise-free smoothness . . . an investment in musical enjo an insurance policy for your records!

NOTE: The use of Micro Diamond Styli is not recommended unless y perfectly satisfied with the performance and condition of your pickup ridge. The perfect reproduction quality obtained from the Micro-Di will serve only to emphasise any cartridge defects





Goldring Diamond Styli ride correctly on the sides of the groove. Inaccurate needles will either ride on the bottom of the groove, causing undue noise and loss of reproduction quality or will skate across the record

MICRO-DIAMOND ADVANTAGES

- **CANNOT BE FRACTURED IN USE.**
- **UNCONDITIONALLY GUARANTEED for 6 months against ture, chipping or accidental damage.**
- **NO RECORD DAMAGE due to worn or deteriorating styli.**
- **NO FREQUENT STYLUS CHANGING.**
- **MORE ECONOMICAL THAN ANY OTHER TYPE OF STYL TERMS OF RECORD "MILEAGE".**

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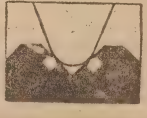
All other softer types of styli eventually wear to chisel edges which gouge records and distort tone quality



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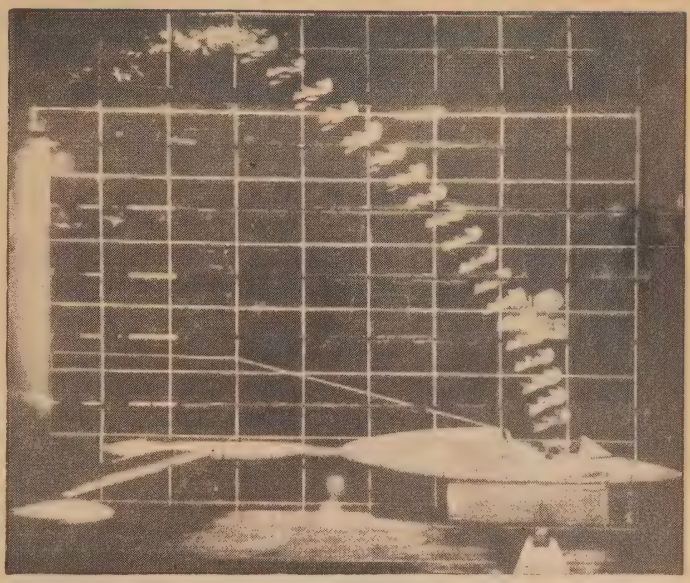

This high speed multiple-image photograph shows how a new aerodynamically contoured pilot escape seat maintains a stable trajectory in this test of a miniature model in a wind tunnel at Pasadena, California The model is made of brittle plastic so that it will shatter against the tunnel ceiling at left, and not damage the tunnel turbine. The seat ejects the pilot in a supine position.

g1 the one containing the factor
s o the event and the other does
is factor can be considered the
e f the event.

he sciences rest on the assump
hat, in similar circumstances
events will occur. These similar
tances are usually a small num
characteristics called variables.
instance, water can be made to
ssuming that certain factors are
. These include the temperature
flame, the purity of the water,
heat conductivity of the kettle
ition, the actual boiling tempera-
"boiling point", nominally 212F,
so vary with changes in atmos-
pressure, etc

IMENTS

scientist then plans an experi-
o test his hypothesis but, before
so, he must decide the kind of
e is studying and the nature of
iables which he believes to con-
event.

problems can be broken into
parts which can be answered
nore simply than together. An
e of this method and its ad-
s is given by E. Bright Wilson
book, An Introduction to Scien-
search.

example is the study of deton
explosives. He states " It
have been hopeless to start with
explosive shell, whose shape, com-
and mode of initiation are too
ated to permit the basic principle
discovered. Instead, essentially
mensional detonations in pipes
died. The length was made great
so that the conditions of initia-
re unimportant and the simplest
chemical mixtures, particularly
were used. In this way a very
ful theory of detonation pro-
has been reached."

greatest precautions are taken to
that experiments are carried out
e least risk of error.

kinds of factors can be respon-
or error and must be carefully
for and guarded against right
the experiment.

h incorrect work is caused by the
the operator, or the subject.

ER OF BIAS

possible for an experimenter to
biased against a certain line of
ng that he looks for results to
his bias rather than the reverse
n important event during the ex
nt could easily be overlooked.

in the subject is illustrated in an
nent to test the efficiency of vita-
in the prevention of colds.

ain subjects who were susceptible
s were given vitamin C pills and
not so susceptible were given imi-
pills. Neither group was told
were controls and which were
s.

people who were subjects showed
ction of 65.5 pc in the number
ls they contracted during the year
ed to other years, and this evi-
was used as proof of the efficacy
min C pills.

somebody discovered that there
so a reduction of 62.7 pc in the
r of colds contracted by those who
e controls and received the "dud"

was a case where the psycholo-
gical effect alone was enough to reduce the number of colds. It is a good example of the power of mind over matter.

It is necessary for the experimenter to guard against the confusing of theorems and their converses. This is like assuming that, because anyone suffering from malnutrition loses weight, everyone who loses weight is suffering from malnutrition.

Chance occurrences arising during the experiment can lead to false conclusions. Therefore the possibility of these occurring must always be considered beforehand. It is prevented by proper controls and repetitions of the experiment.

In medical science the treatment of symptoms rather than the cause of maladies can arise through the mistake of falsely assuming that two events are cause and effect when in reality they are the results of a third hidden factor.

Variables which are extraneous to those being studied can enter an experiment and lead to false conditions. In a noted case purified chemicals were used to study the nutritional requirements of bacteria. It was later found that an impurity of iron in one of the chemicals was just right to provide the bacteria with its requirement of this element.

It has been known that an observer who was kept in ignorance of whether he was viewing the subject or the control gave a biased result. In some way he received a subconscious signal without his knowledge, which influenced his decision. Let us hope that this doesn't happen with a line up of criminals for identification.

Even instruments are subject to bias and can record readings which are not true to the variables under test, but are brought about by extraneous variables which are not fully considered beforehand such as variations of voltage, frequency, impedance and so on.

In the design of apparatus used for particular experiments great pains are taken to see that proper specifications are worked out. Great waste of time can devolve when some apparatus is almost complete only to find that some wanted part is unobtainable.

Every piece of apparatus is usually designed so as to give accessibility to every part. This avoids pulling a model almost to pieces in order to get at one part inside. Witness trying to adjust the idling jet in some motor car carburettors.

TEST EQUIPMENT

Electronic equipment is now almost universally mounted in racks so that each unit can be pulled out on sliding arms. In many cases the units are mounted upside down so that the wiring is accessible when the racks are pulled out.

In all modern labs. the comfort of the operator is considered. Any operator who has to work in an awkward position is likely to get erroneous results. If a delicate flicker of a pointer on a meter is indicative of a momentous discovery it is not likely to be noticed, if the operator has to stand on his head to read the meter and at the same time write with his notebook balanced on his knee.

Scientific experimental work can be very exacting and tiring.

(Continued on Page 79)

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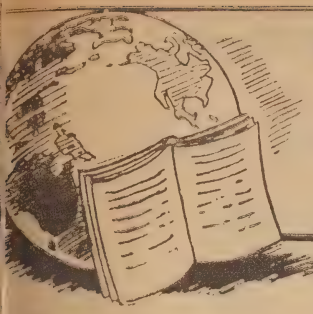


Technical Review

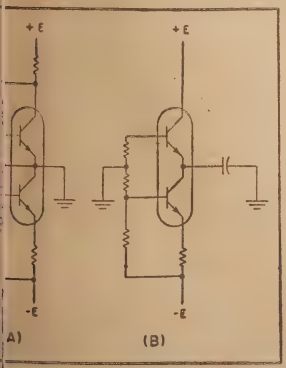
TRA JUNCTION TRANSISTOR SIMPLIFIES DESIGN

dual-triode transistor, with emitter of one unit and collector of the ner section of same germanium region, provides performance of o triode units with considerable reduction of circuit components nen compared to two individual units. A superheterodyne receiver in ich first four stages are replaced with two tetrajunction units is scribed. This information appeared in Electronics for April 1957 as a Hazeltine report.

TENSION of techniques used in ne construction of grown junction stors gives rise to an interesting device that may be applied to a cast receiver. Some modifications rmal circuit arrangements are re- l to obtain optimum performance these units.

N-P-N transistor, often represented olically as a bar with three zones own in Fig. 1A, serves as the base ie development of a bar consisting o transistors formed in a single as shown in Fig. 1B.

en work on this device was initiat- was based on the thought that the approach might lead to significant my in the cost of a broadcast re- because of reduced transistor cost. indications lent support to this ation. At present, manufacturing ques have apparently not advanced point of immediate production.



ire 3—Tetrajunction unit can be sed by connecting collector-emitter ion directly to ground (A) or by nding centre region for AC only (B).

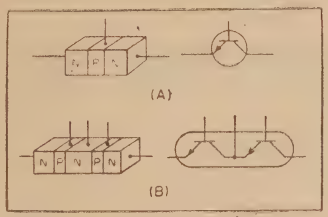


Figure 1—Normal characteristics of triode transistor (A) and those of a tetrajunction unit (B).

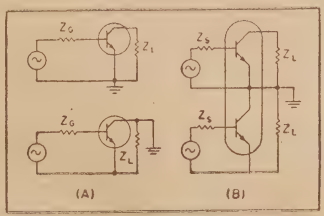


Figure 2—Configurations shown give maximum power gain regardless of ground point. Central collector-emitter region has not produced interaction between the sections so far.

In the tetrajunction transistor, the emitter of one unit and the collector of the other are parts of the same germanium region. This limitation on freedom of connection results in applications of the new transistor being somewhat more involved than for a dual-triode tube.

GENERAL

Since use of a transistor in the common-emitter configuration provides the most power gain, it is generally desirable to operate both sections of the tetrajunction transistor in this fashion. If the input to a transistor is connected between base and emitter and the output is connected between collector and emitter, the emitter is common to input and output, hence the transistor provides maximum power gain. This is irrespective of the ground point in the circuit, as shown in Fig. 2A. All of the circuits in this figure have the same power gain.

As shown in Fig. 2B, operation of the two triodes can be independent. Ground can be placed at any point. In the receiver to be described the central collector-emitter region was chosen, as shown.

The operation of the two halves of the tetrajunction transistor is then as follows: the upper half is connected in a conventional grounded-emitter common-emitter circuit using a bootstrapping technique. In this way the two halves are operating with complete independence. There has been no evidence to date of any interaction between the two sections because of the common use of the single "N" layer.

BIAS

Generally, there are two methods which can be used to provide bias for the triode sections of the tetrajunction transistor. The first is to connect the centre region directly to ground. In this case the two halves have d-c as well as a-c independence, as shown in Fig. 3A.

The second method is to ground the centre region for a-c only. In this case the bias current for both halves is substantially set by the biasing elements for the bottom half alone as shown in Fig. 3B. The choice of use of the two methods will depend, to a large extent, on the type of circuit being implemented.

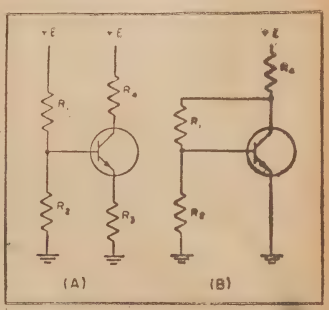


Figure 4—Typical biasing configuration for temperature stability (A) is modified to provide required degree of stabilisation for top triode of tetrajunction unit (B).

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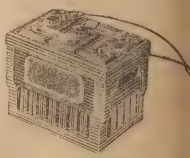

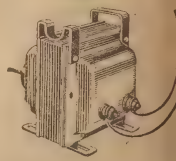

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ond method, however, generally
ill in a component saving.

the tetrajunction transistor is a
that potentially can be used to
the transistors in any existing
design, two at a time: The tetra-
transistors studied to date have
small cross-section, suitable for
RF and audio applications.

of these units plus a diode and
circuit elements can accomplish
functions of a receiver up
the audio driver. No restriction
on the audio output stage and
the popular class A or class B
ments may be employed.

EMS

an attempt is made to use the
ction device in the circuit of an
receiver, several problems arise
of the common connection be-
he emitter and collector which is
y grounded, at least for signal
cies.

the two halves of the device are
s, to achieve the same collector-
voltage as when using two separ-
des in a conventional manner, a
of a higher voltage is required.
wer requirements, in both cases,
r, will be the same. In addition,
e applications, it is desirable that
ttery be centre-tapped. This is
advantage in the receiver de-
The push-pull P-N-P audio stage
e advantage of the full battery
l regardless of the connections
re in the receiver.

E.ISATION

stabilisation circuits require some
A typical method of biasing a
transistor amplifier is shown in
. Here DC degeneration is intro-
by R3 to stabilise the operating
against changes in temperature
variation in transistor parameters
nit to unit. In some tetrajunction
or circuits however, the centre
is grounded. Therefore no stabil-
resistor can be inserted between
tter of the top triode and ground.
ssible to get the required degree
ilisation for the top triode by
e circuit of Fig. 4B, in which R4
es the necessary degeneration.

ver, for a given degree of stabil-
the resistor in the collector cir-
generally considerably larger than
ich would be used in the emitter
Thus with a given size battery
rent in the transistor, there will
rger voltage drop and hence less
applied to the transistor.

the bootstrap technique for the
half of the transistor presents
additional problems. In a trans-
coupled stage, both sides of the
feeding the base-emitter input
with respect to ground as shown
2B. This can at times result in
able coupling to other circuits.
current biasing elements for the
nerally constitute shunt paths to
and may result in a compromise
stabilisation and stage gain.
more, capacitance between the
d ground, such as stray capacit-
capacitance from the high side
nput coupling network to ground,
tes feedback between collector
e, since the collector is grounded.
ay require neutralisation.

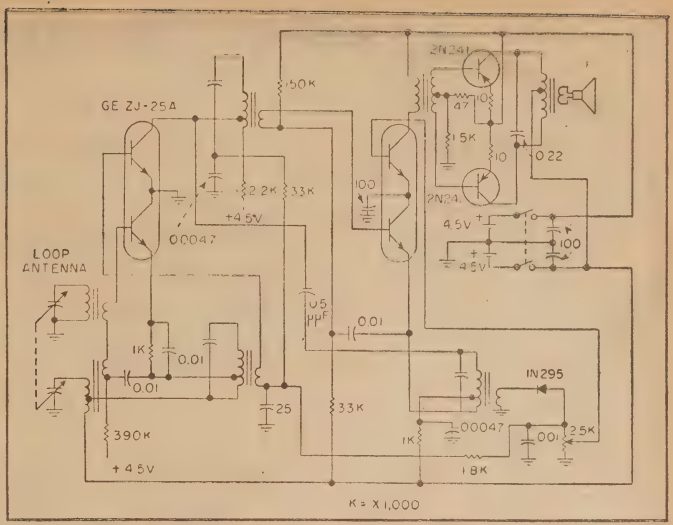

Figure 6—Complete schematic of tetrajunction superheterodyne.

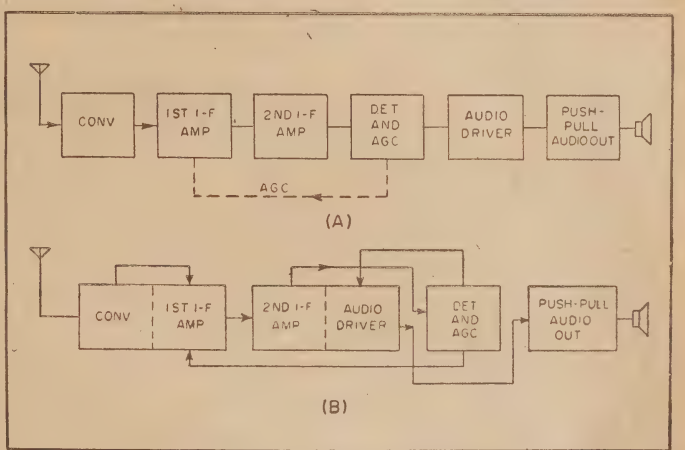

Figure 5—Block diagram of standard superheterodyne receiver using triode transistors (A) and same receiver using tetrajunction transistors (B).

RECEIVER DESCRIPTION

A block diagram of a typical transistor receiver which also applies to a receiver using tetrajunction transistors is shown in Fig. 5A. The set consists of an autodyne converter, two IF stages, a diode detector which also supplies the AGC voltage, and a class A audio amplifier driving the push-pull class B output stage.

Figure 5B shows a modified block diagram of the configuration with each half of the two tetrajunction transistors, as well as two 2N241 audio output transistors. The present arrangement was chosen because it provides an optimum solution to the problems described as well as offering some chance for additional economy. As pointed out before, the receiver uses only two tetrajunction units, two audio units and a diode, while giving the performance of a six-transistor plus diode set. Figure 6 shows the schematic diagram of the complete receiver.

The autodyne converter utilises the bottom half of the first tetrajunction transistor in a grounded-collector common-emitter bootstrap circuit. The oscillator uses a common emitter circuit with feedback from collector to base.

A 1000-ohm resistor bypassed by a 0.01-mfd capacitor is inserted between the emitter and the point common to the input and output circuits. This R-C combination provides low-frequency degeneration in the emitter-base circuit, reduces squegging tendencies and provides some degree of stabilisation.

AERIAL

The loop antenna consists of a ferrite core as large as is consistent with the desired packaging of the receiver. A spaced winding of Litz wire contributes to a high unloaded Q. The maximum input to the converter is obtained with the resistive component of the input impedance of the converter reflected across

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much as the quality of the an-
is affected by its proximity to the
, the antenna becomes a compro-
between the packaging problem.
nt sensitivity, adequate image re-
, ease of tracking and a location
duces undesired coupling.
distributed primary winding tunes
sired range of 535 kc to 1610 kc
220-Pf variable capacitor. The
lary winding transfers the energy
base emitter circuit of the transis-
ing the bootstrap technique. This
e by a direct connection to the
nd through the oscillator tickler
0.01-mfd capacitor to the point
on to the input and output circuits

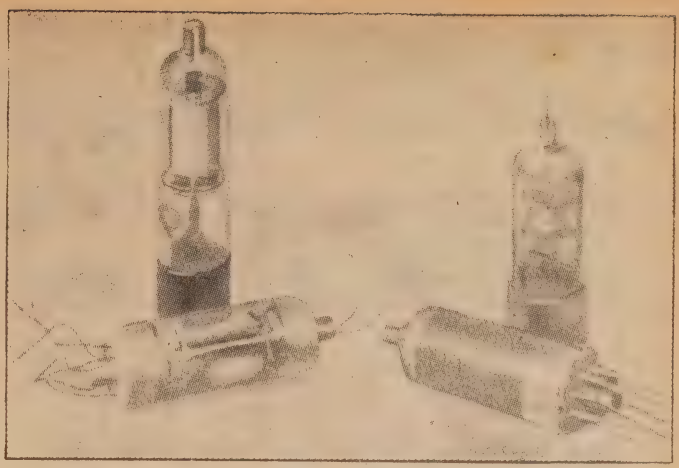
HANNEL

primary of the IF transformer is
ted between the emitter and the
the oscillator tank. Since there
le impedance at IF between this
point and the grounded collector,
nsformer serves as an IF load be-
collector and emitter.
first IF amplifier uses the top half
first tetrajunction transistor in a
ded-emitter common-emitter circuit.
utput impedance of the converter
tched to the 500-ohm input im-
ce of the first IF amplifier by the
IF transformer.
rect stabilisation is obtained by re-
g the 33,000-ohm base bleeder to
llector side of the 2,200-ohm col-
resistor. Any change in collector
nt resulting from variations from
o unit or of temperature will change
oltage across the bleeder. Thus the
nt will tend to be maintained at a
of 1 mA.

e base bleeder and associated cir-
is designed to bias the first IF
stor at 1 mA, place the correct
nt of forward bias across the diode
t 0.10 v), provide satisfactory AGC
and filtering without undue audio
ation and provide satisfactory sta-
ion and a satisfactory load for the
detector. The internal feedback
itance in the individual triode units
ficiently small so no neutralisation
rk is required in most cases.

dering Aluminium ls

ADS of aluminium-wire voice
coils are tinned in less than three
nds at Wharfedale Wireless Works
ngland by dipping in a small bath
olten solder agitated by ultra-
e energy. A cavitation effect in
solder removes the oxide film
the aluminium. The tinned
i can then be soldered conven-
lly. A solder compound of 90 pc
nd 10 pc zinc is used in the bath
temperature of about 450F with a
ime of two to three seconds. The
ard ultrasonic solder pot and
rator used here maintain the
sonic energy at the optimum fre-
cy for maximum soldering
ency.



Final designs and early models (rear) of the 175HQ (left) used in the long Newfoundland-Scotland section and the 6P12 used in the Nova Scotia-Newfoundland section.

20-Year Tubes For Transatlantic Cable

How do engineers manage to send signals over long lengths of cable without loss? Answer—they use built-in amplifiers with valves, that operate for 20 years.

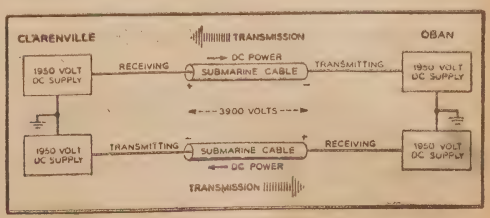
THE new transatlantic telephone cable system depends on the use of hundreds of specially designed very long life vacuum tubes housed in built-in repeaters in the cables lying on the ocean bottom. Repeaters are installed at intervals of about 40 miles in each of the pair of 2000-nautical-mile-long deep-sea cables between Newfoundland and Scotland. Each of the 102 repeaters is a 3-tube circuit used to overcome the attenuation of the cable and to equalise its nonlinear frequency response.

TWO MAIN TYPES

Two main types of tubes are in operation. One, the 6P12, was developed by the British Post Office for use in the shallow-water portion of the system between Newfoundland and Nova Scotia. The other, the 175HQ, was developed at Bell Telephone Laboratories, for use in the deep-sea portion of the system between Newfoundland and Scotland.

The deep-sea tube was designed to function at the lowest practical operating cathode temperature. The plate and screen voltages were reduced to the lowest values consistent with good circuit performance. In addition, electrode spacings were made large. The heaters of the tubes, requiring 225 mA DC are connected in series while the plate and screen voltages for any one repeater are obtained from the voltage drop (about 55 volts) across the heaters in that particular repeater. Hence, the power supply problem is one of feeding a steady current of 225 mA into the cable. The tube heaters for each cable require roughly 2800 volts, and the drop in the cable itself brings the needed voltage to 3900 volts DC. To minimise dielectric stresses, a double-ended series-aiding power feed is used as shown below.

Tubes essentially like those used have been on life test for about 17 years with no failure and there is reasonable probability that these tubes will operate without failure for at least 20 years.



Block diagram showing voltage requirements for the Clarenville-Newfoundland and the Oban, Scotland terminals of new transatlantic telephone cbale.

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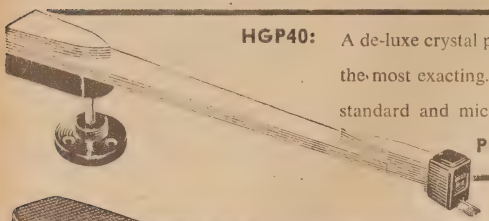
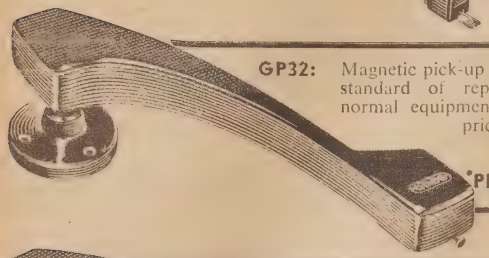
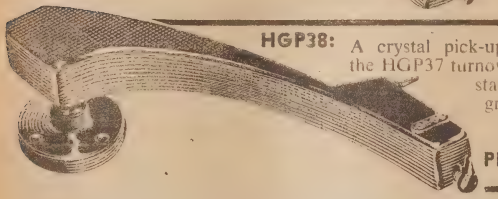


HGP40: A de-luxe crystal pick-up to satisfy the most exacting. Complete with standard and microgroove heads. **PRICE, £9/15/-**



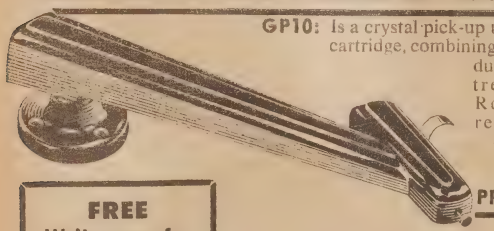
GP32: Magnetic pick-up provides a good standard of reproduction with normal equipment at reasonable price. Output voltage, ½ volt at 1,000 c.p.s. **PRICE, £2/12/6**



HGP38: A crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus. **PRICE, £5/15/-**

GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through *low-gain* amplifiers as used in small record players and some radios. **PRICE, £4/19/6**

GP60: Incorporates the latest-type CERAMIC cartridge—unaffected by heat or humidity. For use in tropical areas. **PRICE, £6/16/-**



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Now famous as the cartridge with the unbreakable crystal. Takes standard steel or fibre needles for 78 r.p.m. records. **PRICE, £1/11/6**

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A CERAMIC cartridge that will withstand the rigours of a tropical climate and is, at the same time, very robust. **PRICE, £3/19/6**

HGP37 CARTRIDGE
A TURN OVER cartridge with cantilever stylus that utilises a new method of crystal drive, a bisectional control element, that achieves independent characteristics for standard and microgroove. **PRICE, £2/18/6**

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NEWS AND VIEWS OF THE MONTH

ngers of radiation

dangers to health and life by rad-
tion of all kinds, including x-rays,
en the subject of grave warnings.
Paul George, Director of the
s Department of St. Vincent's Hos-
refuses to have his family x-rayed.
considers the danger of such de-
is pedascopes—the x-ray machines
show you how your foot fits its
oe—is particularly high.
draws attention to the delayed
of x-ray damage, which may be
manifest years after the exposure
ade.
n the widespread use of x-rays in
sing comes under his criticism.
believes the danger from x-rays
e greater than the danger from TB.
s type of radiation is not the same
t involved in nuclear tests and fall-

ther warnings in this radioactive
were given last month by a US
e Energy Commission scientist, Dr.
Russell.
says that a child can lose 20 days
e for each unit of radiation re-
by its father.
viously it was thought that children
ected persons would suffer only
al or mental injury.
vas previously considered that only
is directly exposed were threatened
ife-span shortening.
says the life-shortening effect
d up in first-generation offspring of
ed mice.
ts on male mice exposed to "mod-
doses" of acute neutron radiation
a nuclear explosion showed:—
gth of life in offspring of the
was shortened by 6-10ths of a
or each unit of radiation received
he father in his reproduction
.

That would mean a 20-day shortening of a childs life, he said.

The data shows an effect on the (mouse) offspring which is as large as the shortening of life in the exposed individuals themselves.

Paris fights noise

THE city that amazed the world by successfully silencing its auto horns and cutouts, and even muffling its all but irrepressible motor-cycles, will now try to pull off another miracle. The Paris Municipal Council is going to throw all its battle-trained anti-noise forces into a spring offensive against blaring radios.

Meanwhile, the hubbub-hating officials of Paris have been digging deeper to get at the source of another urban noise problem. They are putting rubber tyres on Paris subway trains. In the past half-year, they have "rubberised" two of the twelve main lines in the Paris "Metro" network, and the experiment has proved so soothing to "rush-hour nerves" that the subway management plans to spend another £100,000 to put rubber tyres on every subway train in the city.

An official of the subway system has been quoted as saying that passengers riding the "rubberised" routes are showing much better humor, are no longer developing sore throats and hoarseness from the voice-straining arguments they used to have above the din of traditional subway trains, and that "some said it was so quiet and smooth-riding in these subways they can now even sleep standing up."

Electric toothbrush

A BRISBANE dentist, Dr. H. Goldfinch, recently returned from Japan with an electric toothbrush.

He said a Tokio University professor had invented it.

The brush cost about 7/6.

Dr. Goldfinch said the Japanese used the brush with sodium fluoride toothpaste to clean teeth and also combat tooth decay.

The process was similar in principle to the electrolytic process of metal plating, he said.

The electric current in the brush transformed the solid fluoride chemical into liquid fluoride, which then washed over the teeth with the movement of the brush.

Brushing teeth with an electric toothbrush causes a faintly tingling sensation.

The electric toothbrush is slightly longer than an ordinary brush.

It has a small one-and-a -half volt battery in the handle.

Wires inside the brush carry the current to a metal plate underneath the bristles.

Moisture on the hand of the user of the brush and saliva in his mouth cause the electric circuit to close.

In Japan the brushes are sold with a spare battery.

The makers claim that two batteries last as long as the bristles of the brush.

Talking missile gives orders

A TALKING missile, which broadcasts orders to troops from 60,000 feet in the air, has been adopted by the US Army.

The 850lb unit can send a five-minute tape-recorded message by loudspeaker as it descends by parachute.

POPULAR SCIENCE QUIZ

Q: We have heard about the possibility of fuel injection systems replacing carburetors in petrol engines. How does fuel injection work?

The system of fuel injection used in diesel engines involves squirting the fuel directly into the combustion chamber. This requires high pressure pumps and nozzles that can stand combustion heat and pressure.

Most fuel injection systems squirt the petrol just behind the intake valve where a lower pressure is required and cooling problems are not so great. Some time the injection operation to occur during the intake stroke, while others spray continuously from very small nozzles but fuel enters the cylinder only when the inlet valve is open.

Q: What are the advantages of fuel injection?

Various claims and counter claims have been made by various companies, but in general it appears that a worthwhile increase in power can be obtained, the actual figures quoted varying from 10 pc up.

Apart from peak power it is claimed that engine torque at low revolutions is improved. This results in an improvement in acceleration and low speed pulling power.

Petrol consumption is also improved and the percentage improvement is generally of the same order as the improved power, given normal driving conditions. An injection system cuts off all fuel when decelerating or coasting down a hill.

Incidental advantages are that the system tends to be less affected by fast cornering or the attitude of the car. Distribution of fuel to cylinders can be made more even.

A whole series of development may result from the application of electronics to fuel injection systems. A transistor circuit has been made to control the fuel flow from a constant pressure system. The circuit takes into account the manifold pressure, temperature and acceleration and delivers exactly the required amount of petrol. With this system, even changes in fuel requirements with altitude are automatically compensated. Troubles with cold starting may be virtually eliminated.

Q: Are there any serious disadvantages of fuel injection?

Apparently none that cannot be removed by further development and experience. Practically every car manufacturer recognises the advantages of the system and a few are already marketing cars with the new petrol distribution system.

However, the more conservative manufacturers believe that they have not found a system which is cheap and reliable enough to put into ordinary mass produced cars and at the same time able to be serviced by mechanics accustomed to ordinary motor repair work.

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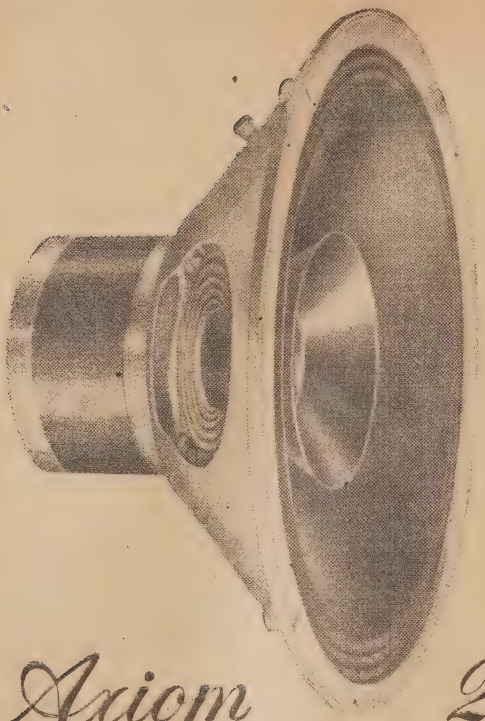

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Nett weight	*18 lb. 4 oz.*

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building for Swiss

Swiss are planning to build the ighest structure in the world — even than the 1472ft Empire State ng.

will be 1815ft high and be built e 1964 Swiss National Exhibition. would, according to reports from nne, have a 15-storey cylindrical supporting a 1300ft slender, steel

the top there would be an obser- tower and restaurant.

102-storey Empire State building es a tower and television antenna. even this project pales into insig- nce against that of an engineer in go.

has been trying to get permission ild a sky-scraper one mile high.

land gets TV

stations in Finland are expected o be in operation late this year. the present time, Finnish viewers programs mainly from Sweden, a and Estonia.

out one-tenth of the total program will be given to commercial tele-

special company will be formed to le programs for commercial clients o hire studios and transmission faci- for these programs from the cor- ion.

is is probably the first commercial ervice in Europe (with the excep- of England) and the idea may be ved soon by other countries.

e Finnish Broadcasting Corporation tarted experimental television pro- s for six hours a week.

ey are clearly visible within about iles of Helsinki.

xt winter, the programs will include entertainment".

y 1960, there will be a full tele- n service for the whole of the hern half of Finland.

ur transmitters have been ordered wo are expected to be installed this They will probably be placed at s and Turku.

nish engineers claim that with a high aerial each of these four es will be able to transmit programs y visible up to about 60 miles away

for traffic control

Police Department may use TV to keep traffic flowing at Sydney necks.

has already been used experimen- in England to observe traffic in vard road sections where a control- policeman can not see vehicles ap- hing a busy intersection (R. TV and ctober, 1956).

nior officials in Sydney are wait- for reports of this TV research on ish roads.

en they will examine the reports cide if TV would suit local condi-

ssistant Traffic Superintendent M. hasing said TV "stations" could be in at the main city bottlenecks, as the Harbor Bridge, Parramatta near Broadway, and Kings Cross. a TV plan is adopted, a policeman be stationed inside a TV box erect- the bottlenecks.

e policeman would spot traffic s and detail mobile crews by radio ntangle them.

WANTED

Radio Officers and Traffic Assistants

for the

OVERSEAS TELECOMMUNICATIONS COMMISSION (AUSTRALIA)

The Overseas Telecommunications Commission operates Australia's overseas communications services through two main telegraph offices, five cable stations and six international radio stations, in addition to the Coastal Radio Service through 23 stations around the coast of Australia and in Papua/New Guinea.

TRAFFIC ASSISTANTS

Vacancies exist for young men up to 19 years of age with the Intermediate Certificate as Traffic Assistants in the Commission's telecommunications centre at Sydney.

Initial duties include recording, sorting and distribution of telegraphic traffic at a commencing salary of £351 per annum for those under 18, rising with age and experience to £796 per annum, while earlier higher salary ranges may be attained by qualifying as Telegraphist, Radio Officer or Radio Technician.

These are permanent positions with free or assisted training facilities and Commonwealth Superannuation.

RADIO OFFICERS *in the Coastal Radio Service*

For holders of a First or Second Class Commercial Operators' Certificate of Proficiency in Radiotelegraphy and Radiotelephony vacancies exist in the Commission's Coastal Radio Service.

Successful applicants who are medically fit have the opportunity to serve at stations situated in all capital cities and at other places around the coast of Australia and in Papua/New Guinea.

The salary range is £886-£1066 for holders of First Class Ticket or £856-£1036 for persons with Second Class ticket. Shift work is involved for which extra payments are made, while other allowances are payable at tropical and remote stations up to a maximum of £320 per annum for a married officer stationed in Papua/New Guinea or at Darwin.

Hours of duty are 36 per week, while annual leave accrues at the rate of from 15 days per annum at southern locations up to maximum of 30 days per annum at certain northern stations

Furnished staff cottages at a moderate rental are available at most non-metropolitan locations.

Early permanent appointment which carries right of entry into the Commonwealth Superannuation Fund is available.

APPLY TO:

The Chief Administrative Officer
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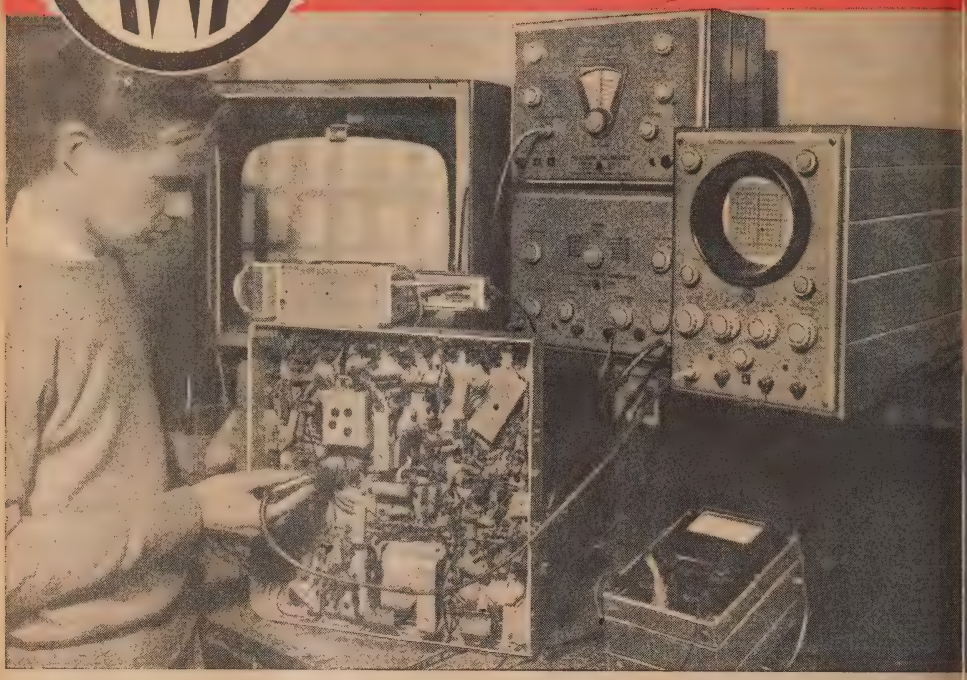
or ring B0544, extension 259, and arrange for an interview.

AWA FOR EFFICIENT



Up-to-the-minute training for TV Servicemen is now available through complete courses in theory and practice at the A.W.A. Marconi School in Sydney and Melbourne. A correspondence course is also provided for those who cannot attend classes.

A good TV business is based on efficient service using the correct equipment and well trained personnel.

A correct choice of instrument combines efficiency in time of operation with best receiver performance and economy in equipment cost. The correct equipment is also less demanding on the skill of the serviceman. A.W.A.'s selection of test equipment is your insurance of efficiency, reliability and economy.

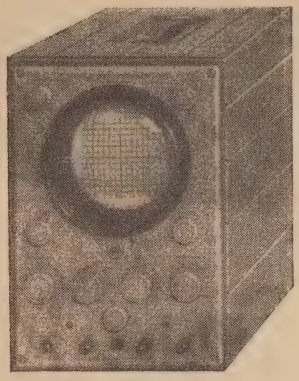
The A.W.A. basic instrument combination provides VISUAL indication and allows analysis of the performance of any stage or stages including overall performance.

Standard T.V. Service Equipment used by

TV SERVICING

A.W.A. 5" OSCILLOSCOPE — A56031

This instrument has the essential features required for TV servicing. Built-in voltage calibrating facilities permit simultaneous wave-shape display and peak-to-peak voltage measurements. Sync polarity may be reversed instantly by a switch.

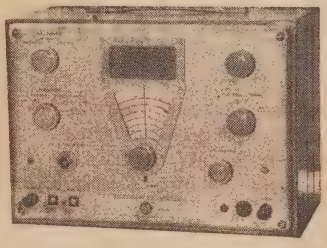


A.W.A. VOLTOHMYST — TYPE A56010

Voltohmyst A56010 is a portable, compact and versatile instrument for the measurement of + D.C. — D.C. and A.C. voltages, D.C. current, and resistance, including signal voltage of valve grid circuits.

A.W.A. TELEVISION CALIBRATOR — A56057

The versatile A56057 supplies a fundamental frequency r.f. carrier of crystal accuracy for use in aligning and trouble-shooting TV and F.M. receivers, and other electronic equipment operating in the range of 19 to 260 Mc. Built-in crystal calibrator, hetrodyne detector, amplifier, and speaker provide 96 crystal calibrating beats at 2.5 Mc. intervals throughout entire tuning range, which is spread over a dial scale length of 144 inches. A built-in 5.5 Mc. crystal provides necessary accuracy for alignment of intercarrier — i.f. amplifiers and discriminators.



A.W.A. TELEVISION SWEEP GENERATOR — A56036

The A 56036 is for visual alignment and trouble-shooting of TV tuners, sound and picture i.f. amplifiers, trap circuits, and video amplifiers. Has preset switch positions for all VHF TV channels, continuous tuning from 50Kc. to 50Mc., high output voltage flat and free from spurious responses. Fundamental signals generated on all channels by push-pull oscillator.

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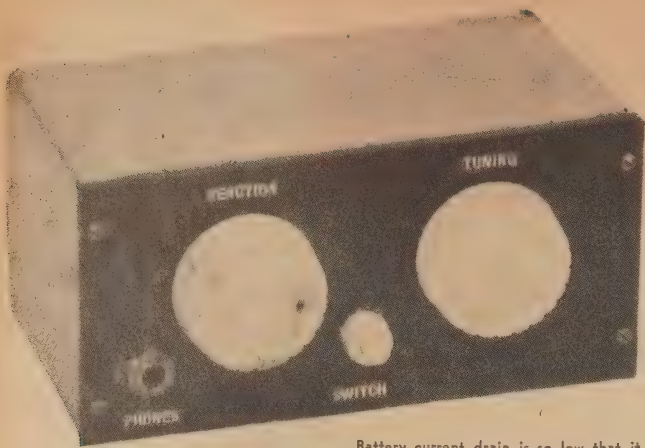

Figure 1. Only 6¾in by 3½in by ... overall our new transistor set has pl... ty of room to spare. You can add ... extra audio amplifier later if you wi...

Battery current drain is so low that it is hardly worth switching the battery off.

A Single Transistor Regenerative Set

A new era in radio homebuilding comes with the introduction of transistors capable o... amplifying efficiently at radio frequencies. This article describes a really attractive littl... receiver using one of the new transistors and at the same time takes an opportunity t... discuss some aspects of transistors in general. Incidentally, the performance of the set wil... give you a surprise. Why not try it?

by Maurice Tindlay

IT gave us quite a kick to be able to sit down and work out the design of a regenerative set using a transistor. We had heard and read about such designs in overseas publications, of course, but that is quite a different matter to making the device work with your own hands.

The novelty angle cannot be denied to those brought up on a solid diet of valves, but there is more to it than that. Simple valve receivers have always appealed to people starting out in radio because they are the obvious way of gaining experience at small cost.

SPECIAL FEATURES

Economy and simplicity which are features of a simple valve set apply more to a small transistor set, which can almost be built in a matchbox if you try hard enough. So little current is taken from the battery that it is almost a toss-up whether it is worth including an on/off switch.

The actual assembly of our new little set is so simple that we would be hard put to it to fill an article describing only how to make it.

We will go into the practical points later on, but most readers will be interested to know something of the advantages, disadvantages and special pecularities of transistors in general.

In starting out on a new subject there is nothing like getting down to basic facts. Here goes.

What is a transistor?

A transistor is an electronic amplifying device made from a semi-conductor material. A semi-conductor has properties intermediate between those of a conductor and an insulator. So far, germanium and silicon are the only semi-conductors which have been exploited to any extent, and the transistors which we buy over the counter in Australia are germanium types.

Physically, the transistors we are interested in are of the order of ¼in diam. and ½in long, with some types bigger and other types considerably smaller.

Electrically, the transistor is, very roughly, analogous with a triode v... (Actually, there are transistors with ... than three elements for special pur... but these have not yet reached the ... eral public in this country.)

The three elements of a transisto... the emitter, the base and the coll... which correspond roughly to the cat... grid and plate, respectively, of a v...

WHICH CIRCUIT?

Valves are mostly arranged in ... cuit such that the input signal is fe... tween the grid and cathode and the ... put signal appears between the plat... cathode. The cathode is, therefore ... common element between the inpu... output circuits.

Transistors are most frequently ... in the common emitter circuit wher... input signal is fed between the bas... the emitter and the amplified outpu... nal appears between the collector ... the emitter. However, the other po... arrangements, that is, common bas... common collector, are often very u...

A fundamental difference be... valve circuitry and transistor cir... should be noted at the very begin... While the current flowing in the o... circuits of valves depends on the V... AGE applied to the control grid ... current flowing in the output circ... a transistor depends on the CURR... flowing in the input circuit..

Instead of a mutual conductance ... many milliamperes per volt as wi... valve, a transistor has a current ga... so many times.

With a valve it is desirable to kee... voltage waveform applied to the co... grid undistorted. With a transisto... the other hand, it is important to ... the current waveform pure. To do ... the input circuit may be driven fr... high resistance source. In some c... it may even be necessary to includ... additional series resistor in order t... duce distortion.

REVISED THINKING

If your introduction to radio has ... via valves, it is often very difficu... stop thinking in their terms when de... with transistor circuits, and if you ... take care there can be endless confu... when dealing with complicated tran... circuits.

Our advice to those who would ke... to make a study of transistor circu... to regard the analogy with the valv... a crutch to be discarded as soon as ... sible.

Before becoming involved in too m... detail about circuitry, it is well w... considering some of the special advi...

d disadvantages of transistors in

y obvious is the advantage of
his has made possible high per-
e pocket radio receivers and
mplete hearing aids inside spect-
mes. The inherent insensitivity of
rs to shock and vibration means
ir life is not likely to be pre-
in these applications.

ner feature of the transistor
ontributes to the success of com-
uipment is its ability to amplify
low power levels. Therefore,
le power is needed for low level
High level stages can be designed
ate with very high efficiency.

DED LIFE

atest transistors have a very long
pectancy because there doesn't
o be anything to wear out.
h it is unlikely that any manu-
would publish a figure for
r life at this stage, it is most
e that it would be many times
a valve—provided always that it
overloaded. In the latter case, it
a matter of seconds.
of the earlier transistors were
rmetically sealed and suffered
arious "diseases" which shortened
ese were referred to as "slow
"sleeping sickness", "sudden
etc. The fused junction tech-
plus hermetic sealing seem to
ercome most of these difficulties.
filament heating current is re-
eliminating one important source
e power and the normal delay of
hode in reaching operating tem-
e. Efficiency, plus elimination of
power has led to the adoption of
ors in electronic computors where
ity has been improved and re-
ents for elaborate cooling systems
l.
ansistorised hearing aid with a
power output can often be made
e a current consumption only
of that of the equivalent valve
aid.
the debit side are a number of
ant factors which make transis-
suitable for many applications.

ATIONS

upper frequency at which transis-
n amplify is quite seriously limit-
rly transistors were hard put at a
ndred kilocycles while those that
ailable now work well up to a
egacycles only. Actually, the upper
epends on the circuit configuration
e common base circuit is usually
ost favorable from this point of

re is reason to believe that the
n will improve within the foresee-
ture to the point where transistors
e of operating at frequencies of
megacycles will be generally avail-

rther limitation on transistor per-
nce is the maximum power hand-
pability. While experimental units
e of delivering power of the order
0 watts have been constructed.
f them are rated for much less
watt.
sistors, particularly the german-
ype, are inherently sensitive to
ature and this factor has to be
ered seriously in the design of
or circuits. It is frequently neces-

REGENERATIVE TRANSISTOR CIRCUIT

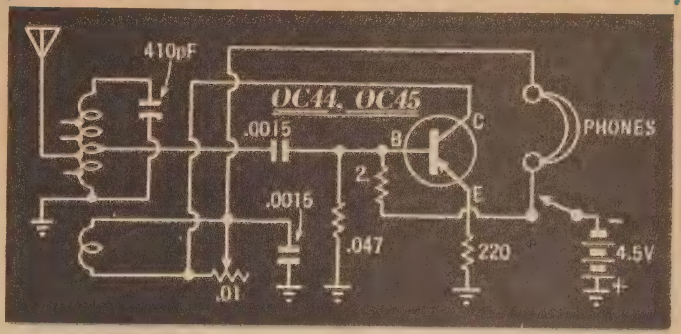

Figure 2. Circuit constants were determined experimentally for best results. Either the OC44 or the OC45 can be used with the former giving the higher gain. Connections to transistor are made by three wires. The wire on the same side as the red dot is the collector, then comes the base and on the opposite side the emitter.

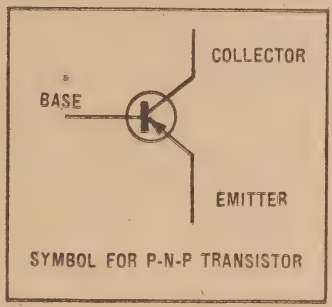

Figure 3. We have drawn the transistor symbol out separately just in case you have not seen it before.

PARTS LIST

Small pieces of sheet metal, bakelite and plywood for chassis, panel and cabinet.

Transistor, OC44 or OC45.

Single section miniature tuning capacitor, 410 pF. 2 0.0015 uF mica or ceramic capacitors.

Potentiometer 10,000 ohms wirewound or carbon. 1 2.0 meg resistor, 1 0.47 meg resistor, 1 220 ohm resistor. (Resistors may be either ½ or 1 watt.)

Phone jack, miniature switch, tag strip, terminals, three dry cells, 2 terminals, 2 knobs.

Coil is wound on ¾in diam. former. *Tuned winding is wound to a length of 1¼in with 32 B & S wire and tapped at 1/8in, ¼in, ½in and ¾in. Reaction winding is wound to a length of 3/8in with 36 B & S wire.

Alternatively, for extra feedback a 2 layer coil ¼in long Both 1/16in from earthed end of tuned coil. Both in same direction.

sary to introduce special circuits in order to keep the transistor operating on the desired part of the characteristic curve.

At high temperatures the characteristics of transistors change so drastically that it is no longer possible to use them. Present germanium transistors could not, in general, be recommended for use in car radio receivers in Australia because of the high temperatures encountered in closed cars standing in the sun. Development is taking place along these lines and designs for car radio sets have appeared where a combination of valves and transistors is used, the place of mounting the transistors being specially selected for low temperature.

EARLIER TYPES

We have already described some small transistor receivers but these used transistors, such as the OC70 and OC71, which are not capable of amplifying efficiently over the entire broadcast band. As a matter of fact, their efficiency falls off quite markedly even at frequencies lower than the low frequency end of the broadcast band.

As proved by the earlier designs the OC70 and OC71 are capable of functioning as quite efficient detectors at broadcast band frequencies but the inability to amplify efficiently means that regeneration cannot be included.

The effects of adding regeneration are well known to most small set enthusiasts. Both the amplification and the selectivity are greatly improved.

If too much energy is fed back the detector will oscillate. However, if the feedback is adjusted so that the system is just on the verge but not actually oscillating the improvement in performance can be very spectacular.

It is not unusual for the amplification with regeneration to be almost as great as that obtained by adding another valve and the selectivity to be even better than would result if an extra tuned circuit were included.

Samples of two types of transistors which are capable of amplifying at broadcast band frequencies have been on hand for some weeks and there is

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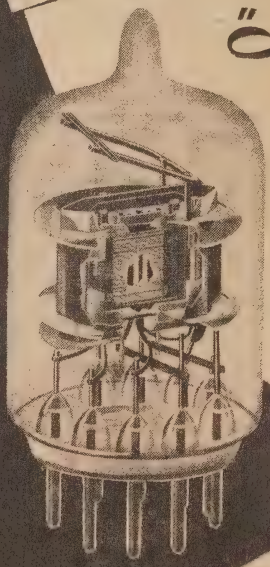

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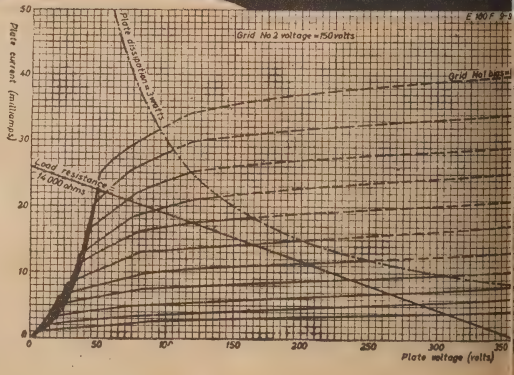

PHILIPS

** Due to the fact that this tube has not been in production for long enough to complete life tests, this figure is given tentatively and does not imply a warranty.*

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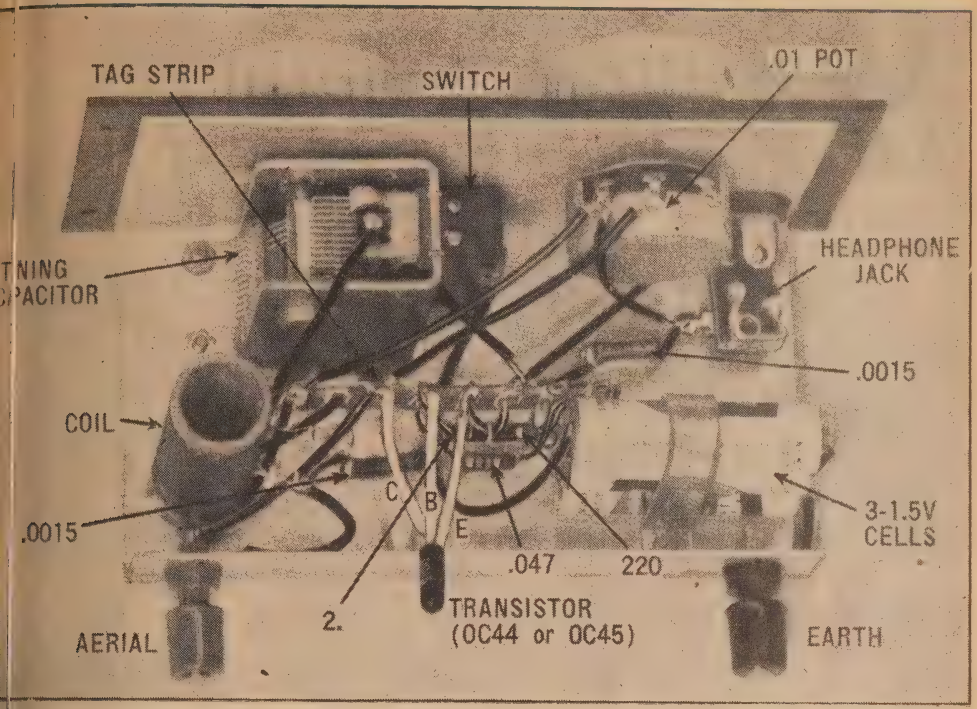

e 4. This photograph is about full size and allows you to follow practically every connection. The transistor leads are left long ve have bent it out of the way so that you can see the tag strip. Use a pair of long nose pliers to hold the leads when soldering to prevent excessive heat conduction.

indication that they will shortly ailable in sufficient quantities to f the demands of small set build-

urally, as soon as information on high frequency types did become le we thought about possible uses m.

ortable receiver with extreme bat- onomy is an attractive possibility a compact self-contained signal tor for service work could be without the usual special difficul- filtering power leads to prevent . There are many others about no doubt, you will hear in the

E PROJECT

re is a fair amount of develop- work behind the circuitry of a le portable and, frankly, we like to have a few months to com- he design and give it a practical rrangements have to be made for e coils to be produced and made le through the usual channels. r, we would like to feel a little certain of the supply of high- ncy transistors in quantity before ng time and space to the project. a small regenerative receiver using he one high frequency transistor e a different matter. Supplies are hat you will not have too much difficulty in getting the transistor while the coil you require can easily be home wound.

So much for the idea. The next job is to translate it into a practical working receiver. This is not quite as straightforward as may first appear because of the fundamental differences between transistors and valves.

Before tackling the transistor, it is worth pausing for a moment to consider just how an ordinary regenerative detector works with a valve.

In analysing the circuit it can be shown that a conventional regenerative detector actually performs three separate functions.

Figure 5a is the circuit of an often used regenrative detector, while from figure 5b you can see the resemblance b tween the grid and cathode of the valve and the plate and cathode of the diode in an ordinary detector unit.

CIRCUITS EXPLAINED

The capacitor has a low reactance at radio frequencies but is virtually an open circuit as far as audio frequencies are concerned while the resistor behaves as a diode load. The source of signal is normally a coil which has negligible reactance at audio frequencies. It is not hard to see, then, that the detected audio signal appears effectively between the grid and the cathode of the valve.

This isn't a suitable place to analyse

TRANSISTOR CIRCUITS COMPARED

	Common Base	Common Emitter	Common Collector
Valve Analogy	Grounded Grid	Common Cathode	Cathode Follower
Current Gain	Approx. Unity	High (say 50)	High (say 50)
Input Impedance	Low	Medium	Usually High
Output Impedance	High	Medium	Usually Low
Max. Frequency	Figure Usually Quoted	Lower than Figure Usually Quoted	Varies with Circuitry

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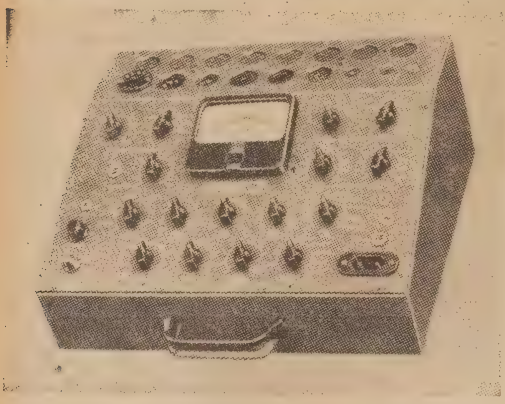

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(8) Finally—all transformers are thoroughly tested for final performance.

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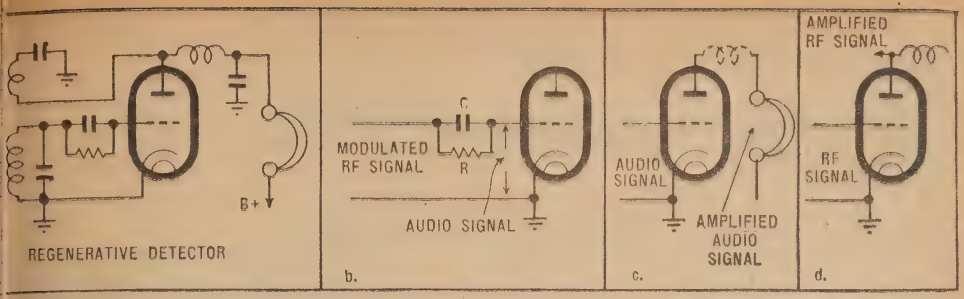


5. These diagrams break up the separate functions of a re generative valve detector in order to make the problem of designing a regenerative detector with a transistor easier to understand.

ation of the detector in detail
n be seen that a steady voltage
n between the grid of the valve
h, the value of the voltage de-
on the strength of the carrier.
l becomes negative with respect
cathode an thus in a suitable
n to amplify audio signals with
stortion.

e 5c shows the circuit elements
e concerned in the audio ampli-
tion of the detector. Since the
equency choke in the plate cir-
he valve has negligible reactance
the highest audio frequency, the
ignal appears across the head-

FREQUENCIES

dio frequencies, Figure 5d, the
oil has a high reactance and
a radio frequency voltage avail-
he plate to be fed through some
liate control circuit and back to

e design of the circuits a com-
must be chosen between ef-
as an amplifier of radio frequen-
f efficiency as an amplifier of
equencies. For example, a high
ad resistance may be needed in
o give a high audio frequency
he high value resistance results
alve operating with a lower plate
drawing a lower plate current
ing less gain at radio frequen-

ally, it is more important to have
n at audio frequencies since only
fraction of radio frequency out-
d be fed back in order to make
ctor oscillate.

A TRANSISTOR

let us consider how a transistor
made to operate as a regenerative
and perform the same functions
ve regenerative detector.

three possible circuit arrange-
or a transistor each have special
ges. These have been summarised
able given here. Our main con-
to design the circuit to give the
n audio gain combined with effi-
tection, provided always that the
equency amplification is sufficient
able regeneration.

the table it may be seen that
mmon emitter circuit has the
ristics required except that the
m operating frequency is lower
the common base.

ave carried out some experiments
h the OC44 and the OC45 which
hat both are capable of provid-

ing sufficient gain at radio frequencies for regeneration in the common emitter circuit. Hence, circuit development proceeded with the transistor wired in this way.

The first job was to establish a circuit condition for efficient detection consistent with good audio frequency amplification. This was done purely on an experimental basis with the signal fed into the base of the transistor from a signal source, a resistor being added in series with the signal generator in order to simulate the source resistance of the tuned circuit to be used in the final model. A coupling capacitor was included in order to preserve the bias condition.

Following this, the tuned circuit was actually connected and it was confirmed that an efficient transfer of energy could be made if the base were tapped down the coil. Headphones were placed in the collector circuit making the set into a detector plus audio amplifier device.

THE REGENERATION

The next job was to add the regeneration and we tried several schemes which involved varying the collector to emitter voltage in order to vary both the gain and feedback. Here we came up against a practical demonstration of one of the features of transistors—their ability to amplify with very low applied voltages.

With enough feedback to ensure reliable regeneration, the applied voltage had to be reduced to the point where the maximum power output of the stage was too low even for good headphone volume before the detector would stop oscillating.

The best solution appears to be to devise a means of controlling the regeneration which does not alter the operating voltages. When this is desired in the case of valve circuits a variable capacitor is frequently used to control the current through a series circuit consisting of a coil and the variable capacitor.

OUR CIRCUIT

Possibly this can still be done with the transistor set although it may be necessary to use a physically large capacitor in order to obtain a sufficiently low reactance.

We felt that a more convenient approach to the problem was to connect a potentiometer across the feedback coil so that the amount of radio frequency energy coupled back in the base circuit of the transistor could be varied by varying the shunt resistance.

A disadvantage of the circuit is that the damping on the tuned circuit is high when the resistance in shunt with the coil is low. In practice this is not important, since the set is almost invariably operated close to the verge of oscillation, where losses in the tuned circuit are compensated by the effects of the reaction.

In practice, the reaction control works quite smoothly and it is easy to bring the circuit to the verge of oscillation

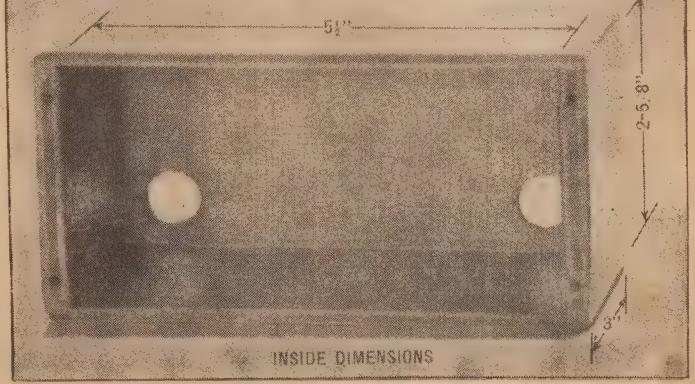
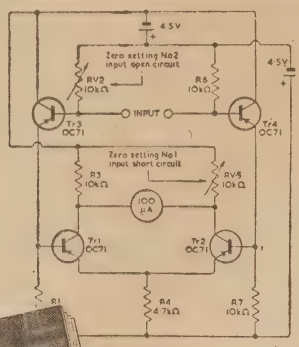


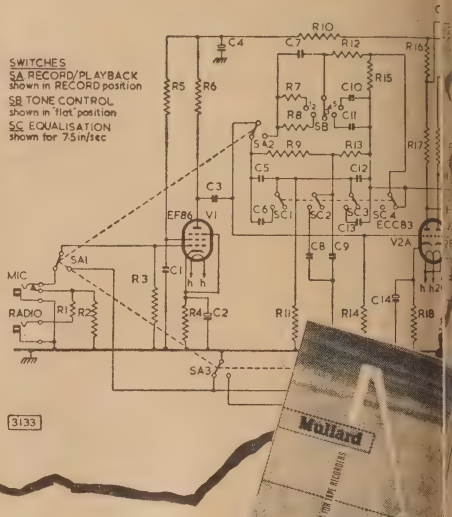
Figure 6. A wooden cabinet for the set takes only an hour to make and puts the finishing touch to a neat little project.

2 NEW PUBLICATIONS FROM Mullard

only the top of the wedge is fluorescent, and then that too becomes cut off; the dot is the last part of the display to be extinguished.
When the bridge is balanced, there is zero input, the 'eye' is open and gives the full 'exclamation mark' display.



mplification of nearly a', thus causing a voltage
meter which is proportional to the applied



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it actually slipping into the oscil-
condition. Under certain condi-
here is some electrical backlash
system, i.e., the control has to be
t back past the point where it
to oscillate in order to make
ion cease. When this happens,
t way to get over the problem is
ually increase the reaction control
while rocking the tuning control
d forth over the required station.

POSSIBLE TYPES

transistor used has some effect on
havior of the reaction control as
the overall performance of the
Originally we used type OC45,
appears to be more readily avail-
the moment, and the circuit con-
coil, data, &c., were adjusted for
rformance with this type.

equently, we had the opportunity
an OC44, which has higher fre-
ratings and a higher current am-
ion factor than the OC45. Re-
ere improved to a worthwhile de-
nd we would judge that the per-
ce with the OC44 is appreciably
than most one-valve receivers.
nance with the OC45 is about
o that to be expected from a one-
set.

e isn't a great deal to the con-
on of the set. The physical form
e used is only a suggestion, and if
ve ideas about making it in any
cabinet you already have, there
eason why you should not do so.
il is the only component which is
of mounting position and it
not be placed hard against the
of the tuning capacitor or any
expanse of metal. A reasonable
um distance would be ½ inch.

a on the coil is given in parts list
ou will note that it is wound on a
diameter former. The idea is
ou can make the set fairly com-
you wish.

HANICAL

secured the coil to the chassis plate
king a pair of diametrically oppos-
cksaw cuts, each 3/8in long and
4in from the end of the former.
e of scrap sheet metal 3/8in wide
4in long, with a hole through the
, is pushed through slots. The coil
ien be mounted on the chassis or
eboard by a single bolt or wood

chassis for our own model of the
is made from a piece of scrap
ium 6in by 5 3-8in wide. A line
narked 2½in from one of the
in sides and another line 5-8in
the other and both sides bent up
t angles in the same sense leaving
chassis 2 7-8in wide.
p bakelite cut to 6 1-8in by 3in
sed for the front panel in our
ut the exact dimensions will vary
he thickness of the wood used for
binet.

IBLE TRAP

e carefully that most phone jacks
one of the terminals common with
ounting frame and will cause a
rcuit if they make contact with
tal chassis. We cut a large hole in
assis so that the jack was support-
the bakelite panel.
ement of the tuning capacitor, re-
control and switch can be seen
photographs. The switch is a

miniature type sold for replacement purposes in bedlamps. Contact is made through corresponding terminals on opposite sides of the switch in our case, not adjacent pairs.

Most of the wiring is supported by a tag strip bolted in the middle of the chassis. It has a total of eight lugs, two of them being earthed.

Three dry cells are mounted in a vertical pile and held to the chassis by a strap made from scrap metal. A couple of layers of paper or insulating tape will ensure that the strap does not cut through the paper around the batteries and cause a short. Current drain of the receiver is only about 25 microamperes and the smallest dry cells you can buy will have a long life.

The cells should be connected in series to make up a 4.5 volt battery with lengths of tinned copper wire. The positive terminal of the battery connects directly to the chassis, a point which will seem strange to people used to wiring valve circuits.

CORRECT POLARITY

Damage to the transistor may result if battery connections are reversed.

In operation the set won't behave quite the same as the usual valve regenerative receiver but you will soon learn how to adjust it for best operation. The capacitor leading to the transistor base will normally be connected to the third tab up from the bottom of the coil. You can try other positions but it is not likely that you will do any better than the recommended position.

For a long aerial, it will be best to connect the aerial terminal to a tap right down near the earthed end of the coil while if you are using only a few feet of wire, the aerial can be connected to a tap up near the top. In the western suburbs of Sydney, for example, you will be able to receive all local stations at good headphone strength with only about four feet of wire for an aerial.

POSSIBLE EXPERIMENTS

Some adjustment of the number of turns and placement of the feedback coil is permissible if you would like to experiment. However, don't assume that the set is not oscillating if you don't hear a "plop" in the phones when the reaction control is advanced because the set slides into oscillation almost imperceptibly.

You can make the circuit oscillate more readily by shorting out the resistor in the emitter circuit (220 ohms) but we found that the overall performance was smoother to a worthwhile degree with the resistor in place without upsetting the operation of the detector and amplifier appreciably.

We made a cabinet for the set from a few scrap pieces of plywood. The ends are 3/8in ply and the rest 3/16in ply. Cold water casein glue will make a strong job while a few small panel pins can be used to keep the parts in place while the glue is setting.

Give the glue 12 hours at least when the whole job can be sanded, the corners rounded and a coat of paint applied. For a really smooth job a couple of undercoats plus treatment with fine sandpaper between coats will be worthwhile.

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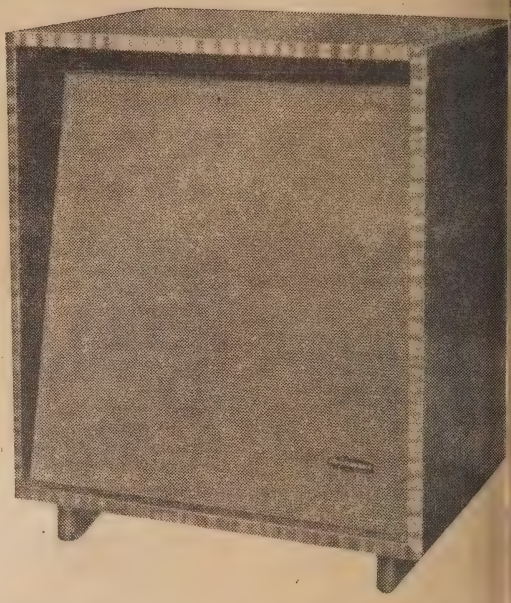

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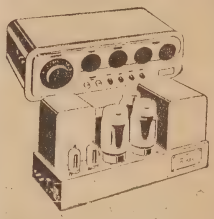

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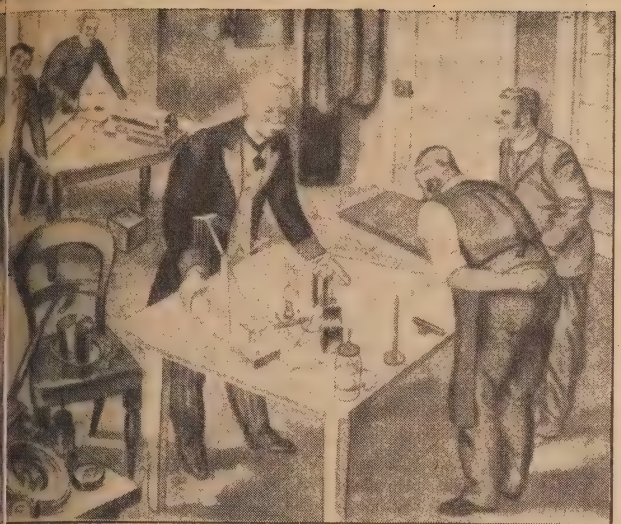

tist's conception of Sir Ambrose Fleming, who invented the thermionic valve, eting the historic experiment which proved his theory that it could detect signals.

he Valve—Aladdin's amp Of Radio

Electron Emission, Cathodes and Plates, The Diode and Rectification, Triodes and Amplification, The Screen-grid Valve, Pentodes, the Beam-Power Valve, Valve Development, Frequency Converters, Multiple Types.

is probably correct to say that the thermionic valve is the heart of modern radio aparatus, and the purpose of this chapter is to study the theory and the operation of these onderful devices. The discussion recalls many facts already stated in earlier chapters, but opens up a whole new vista of thought for the student.

ave already seen that all mat-, whether in solid, liquid or gase-m, is made up of innumerable Further, that these atoms are ed of protons and electrons in a t state of motion.

naterials known as conductors, of the outer planetary electrons nder from one atom to the next e or less random fashion. We into our discussion of valves from nt.

random movement of electrons accelerated by increasing the tem-e of the conductor—usually one or f the metals.

TRON MOVEMENT

he temperature is gradually raised, ocity of electron movement in- and a condition may ultimately hed where some of the planetary s acquire sufficient velocity actu- break beyond the confines of the tor. However, because of the at- of the parent body and the out- lanket of air, the electrons so ED return immediately to the body.

itions are different when the g agent is contained within an evacuated space.

With no gas molecules to bar the way, the electrons emitted from a heated conductor can move an appreciable distance from it. In the normal way, the loss of electrons leaves the parent body with a positive charge, so that it acquires a marked attraction for the minute negative particles. They shoot out from the surface of the heated conductor, then fall back again.

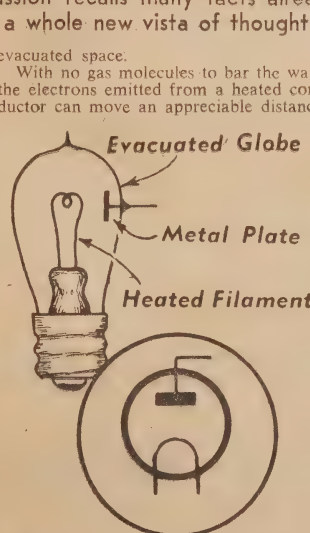

Figure 1. An elementary form of diode rectifier and (in circle) the schematic symbol for a diode.

ELECTRON EMISSION

The net result is that the heated body is surrounded by a cloud of free electrons, like steam above the surface of boiling water. These free electrons can nevertheless be attracted from the immediate vicinity of the parent body by the simple expedient of placing a positively charged metal plate elsewhere within the evacuated space.

The effects of this so-called "electron emission" were first noted by Thomas Edison in about 1880. Edison discovered that an electric current could be made to pass the completely empty space between the heated filament of an electric lamp and another metallic conductor contained within the same glass envelope.

The effect was duly noted but was unexplained until about 1899, when the electron theory was first propounded.

When the reason for the current was appreciated, and something of its characteristics investigated, its application to the new science of wireless communication was envisaged. Electron emission ceased to be a mere incidental effect and became a phenomenon to be controlled and utilised.

Essential features of a radio valve are, therefore, a heated electrode to supply free electrons, and one or more additional electrodes to control and utilise their flight—the whole mounted within an evacuated envelope.

CATHODE OR FILAMENT

The electrode supplying the electrons is commonly referred to as the CATHODE and is usually heated by the passage of an electric current, in precisely the same manner as the filament of an electric light globe. The shell enclosing the evacuated space may either be of metal or glass, the latter being the most common.

Before going on to investigate just how the emitted electrons are controlled and utilised, it is as well to become familiar with the emitting electrode—the cathode.

For many years, the cathode was a tungsten or similar wire, heated by the passage of an electric current; because of its similarity to the element in a light globe, this type of cathode was—and is—commonly referred to as a FILAMENT.

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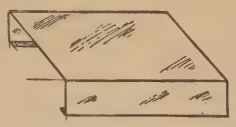

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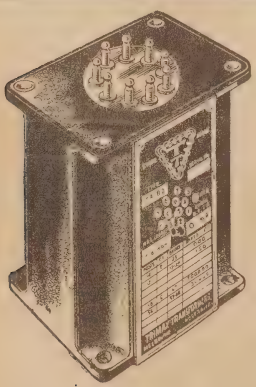

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ce the heating current is utilised
ly to raise the temperature of the
ing surface. the filament is called,
chnical language, a DIRECTLY
TED CATHODE.
f the early valves, the filaments were
r ally of pure tungsten, which emit-
l goodly supply of electrons when
d to a brilliant white heat. Sub-
nt experiment showed that similar
ion could be obtained, with greater
omy in heating power, by impreg-
g the tungsten with thorium and
ting the filament at a bright gold

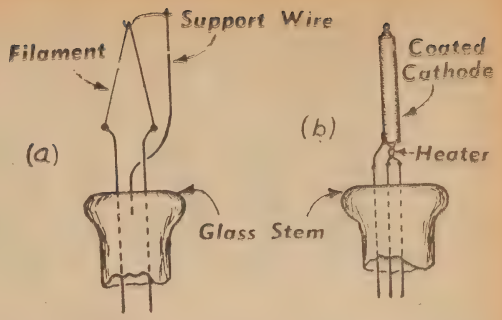

Figure 2. A directly heated filament is illustrated on the left and, on the right, an indirectly heated cathode.

DE COATING

nstant research has produced the
rm OXIDE-COATED filament,
t gives a copious supply of electrons
temperature sufficient only to heat
lament wire to a dull red color.
e current utilised to heat the fila-
in a sense, represents a waste of
r, since it does not contribute
r to the basic function of the valve;
for most purposes, there is every
n to reduce it to an absolute mini-

from it, is a folded or twisted HEATER wire. Current passing through this wire raises it to a bright red heat, and the nickel sleeve soon become heated by conduction.

The fact that the emitting surface is isolated electrically from the heater confers an advantage which is much appreciated by the designers of radio receiver circuits.

Unfortunately, the indirectly-heated cathode requires a fair amount of heating power, so that it is seldom used in battery-operated equipment.

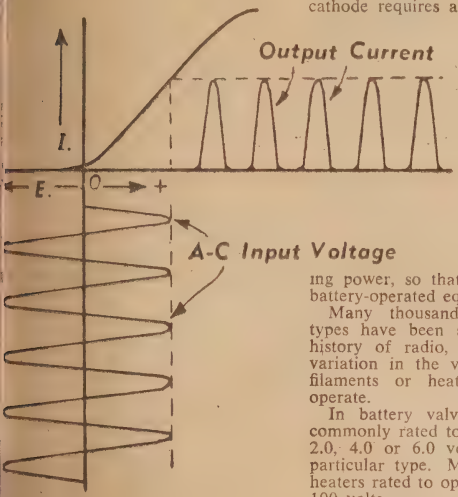

Figure 4. Illustrating the rectifying action of a diode. Only the positive half-cycles produce an output current. Negative half-cycles are suppressed.

lament-type (or directly-heated)
des are chiefly used nowadays in
es intended for battery-operated re-
rs, their particular advantage being
omy of filament heating power.
e battery used to supply the fila-
s is commonly referred to as the
battery. A typical filament is illus-
d in figure 2a.

IRECT HEATING

equipment intended for power mains
ation, there is not the same need
xtreme economy in cathode heating
r, and the filament in directly-
d mains-type valves is commonly
e heavy and robust. However, be-
e it confers a number of advantages,
so-called INDIRECTLY-HEATED
THODE has been developed and is
widely used. It is illustrated in
e 2b.
he electrons are emitted from the
ace of a thin nickel sleeve, which is
ed with a special preparation. In-
the sleeve, but insulated electrically

Many thousands of different valve types have been sold within the short history of radio, and there is a wide variation in the voltage at which their filaments or heaters are intended to operate.

In battery valves, the filaments are commonly rated to operate at either 1.4, 2.0, 4.0 or 6.0 volts, according to the particular type. Mains-type valves have heaters rated to operate from 1.6 to over 100 volts.

When installing a valve in a receiver, this matter has to be kept in mind, as the application of an excessive voltage to a filament or heater may completely ruin a valve.

Coming back to the original line of thought, let us assume that we have a metal plate mounted within the evacuated envelope and in proximity to the heated cathode. This second electrode can quite correctly be referred to as an ANODE or a PLATE.

If it is connected externally to the cathode, a few high velocity electrons may strike it and return ultimately to cathode via the external connecting circuit. However, the vast majority of the emitted electrons remain in the immediate vicinity of the cathode, forming what is known as a SPACE CHARGE.

Think of this space charge as a restless cloud of negative electrons—and therefore a negative charge.

If a battery is connected between cathode and plate in such a way that the plate is negative with respect to cathode, it naturally tends to repel any electron which happens to approach it. Remember our former axiom—like charges repel.

Reversing the polarity of the battery so that the plate is made positive, has just the opposite effect, the plate tending to attract electrons to itself; the higher the applied plate voltage, the greater the attraction, and therefore the greater the electron flow across the space between cathode and plate.

SATURATION

A point is ultimately reached where the plate attracts every electron the cathode is capable of emitting, and when this stage is reached, the valve is said to have reached saturation point.

The whole relationship is most easily illustrated with the aid of a simple graph, as shown in figure 3. Plate current is plotted in a vertical direction, and plate voltage, positive and negative, along the horizontal axis.

There is no plate current while the plate is negative with respect to cathode, but a small flow becomes evident in the region where plate and cathode potentials are similar.

Beyond this, an increase in positive plate voltage is accompanied by an increase in plate current until ultimately the region of saturation is reached.

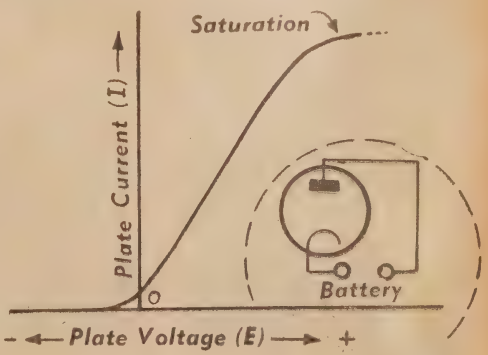

Figure 3. Characteristic curve for a diode. Plate current flows only when the plate is positive with respect to cathode.

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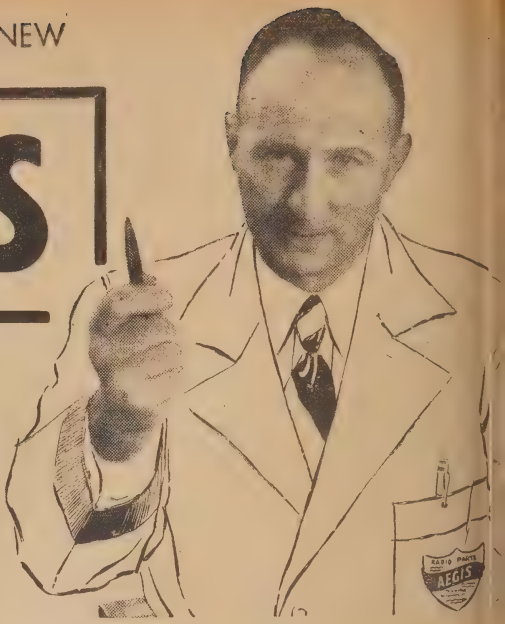
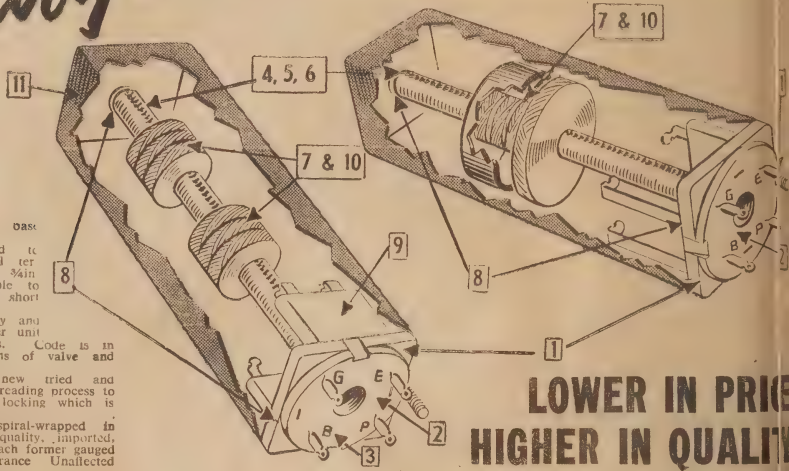


Above Charles van Scoy, Chief Aegis Design Engineer



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lve having a plate and a cathode
it r directly or indirectly heated—is
nly known as a DIODE.
what happens when an alternating
is applied to a diode is illustrated
re 4. The voltage/current curve
n redrawn and the quantities are
ted by the common abbreviations
r voltage) and "I" (for current).

DE ACTION

added curve at the bottom sug-
he application of an alternating
which swings the plate alter-
y positive and negative. The diode
current only on the positive
the negative swings having no

ability of a diode to suppress the
e peaks of an alternating input
n an extremely valuable feature,
ocess being described as RECTI-
ION.
le valves, with heavy cathodes and
lates, are widely used to convert
ting current to direct current in
supplies for radio equipment, large
all.
r diode valves, small enough to
in the palm of the hand, play
part in radio receivers in making
gnals from a broadcast station
in the loudspeaker. The whole
of rectification is a big one, but
e can be said of it just now.
le valves of various patterns were
uite extensively in the early days
io, but in 1907 Dr. Lee De Forest
ed a type of valve rather like pre

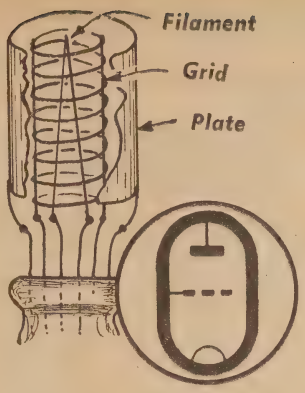

Figure 5. The arrangement of electrodes within a simple triode. The schematic symbol for a triode is shown in the circle.

be reached where the electron current to the plate is cut off altogether.

On the other hand, making the grid positive with respect to cathode has an accelerating effect on the electron movement, so that the plate current is made higher than would normally be the case.

Of course, the positively-charged grid is likely to attract a certain number of electrons itself, giving rise to grid current. This is a condition which is generally avoided. Instead, the valve is designed to operate normally with a certain initial negative grid voltage, known as a BIAS.

Making the grid more or less negative than this initial bias voltage decreases or increases the plate current with respect to its initial value.

The degree of control which the grid exercises over the plate current depends very largely on the physical construction of the valve. However, De Forest's triode demonstrated conclusively that a small voltage applied to the grid could exercise control over a plate circuit in which comparatively large currents were flowing.

In modern triode valves of quite ordinary pattern, a change of 1.0 volt on the grid can effect a change of 10 or more milliamps in the plate current. Here is a chance to recall and apply Ohm's Law, as mentioned in an earlier chapter.

In figure 6, the plate of a triode is shown connected through a PLATE LOAD resistor to the positive terminal of a battery. This is commonly referred to as the "B" or high tension supply battery.

The grid, on the other hand, returns to an adjustable resistor across a "C" or bias battery. No heater supply is shown, it being taken for granted that this requirement is attended to as a matter of course. Note that both batteries are connected to the cathode of the valve.

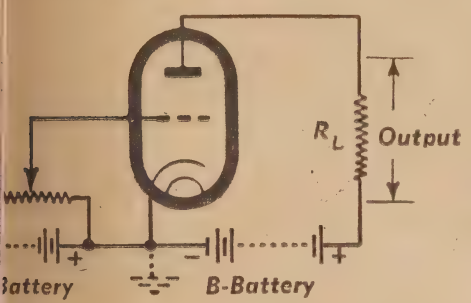

Figure 6. With the aid of this diagram and a simple Ohm's Law calculation, the amplifying property of a triode is clearly demonstrated. The plate load is shown as a simple resistor, but it may be any device offering a substantial impedance to the flow of alternating current at the signal frequencies.

AMPLIFICATION

In equipment operating from the power mains, the various batteries are supplanted by electronic power supply equipment, but the traditional terms "A", "B" and "C" supply are still often used to distinguish filament (or heater), high tension, and grid supply voltages.

Assume that the grid bias of the valve is set at —4.0 volts, and that it is drawing a plate current of 3 milliamps through the load resistor, equal to 50,000 Ohms. The voltage developed across resistor RL by this current would be:

$$E = I \times R$$
$$= .003 \times 50{,}000$$
$$= 150 \text{ volts.}$$

If the grid bias voltage is now increased to —5.0 volts, we may find that the plate current has decreased by, say, 1.0 milliamp, so that the voltage drop across resistor RL becomes:

$$E = .002 \times 50{,}000$$
$$= 100 \text{ volts.}$$

In other words, a change of 1 volt on the grid has effected a change of 50 volts on the plate potential.

It follows that, if an alternating voltage of 1.0 volt were applied to the grid, an alternating voltage of no less than 50 volts would appear in the plate circuit. In other words, the triode, with its associated components and power supply, is capable of AMPLIFYING a signal.

Not all triodes can achieve an amplification of fifty times, as our illustration might suggest, but the importance of this development is not hard to imagine. Diode valves could only alter the nature of an incoming radio signal; the triode could do this, if necessary, and amplify it into the bargain!

Signals from radio stations too weak to be discerned with equipment using a diode valve were amplified to complete audibility with triodes.

Nowadays, one-valve sets using a single

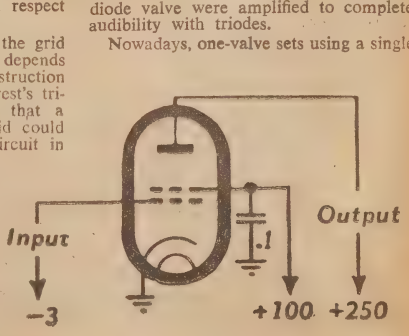

Figure 7. The basic circuit connection for a screen-grid valve, represented schematically, and showing typical operating voltages for the grid, screen and plate.

diodes in construction, but with a electrode interposed between the le and the plate.

mmonly called the CONTROL (or simply the grid), this third ode proved to have a pronounced on the number of electrons pass- om cathode to the positive plate.

Forest's valve, known as a TRI- is illustrated pictorially and atically in figure 5.

grid usually resembles in form a length of open mesh helical spring, led with one or more side rods upport.

ION OF THE GRID

he grid is unconnected, the elec- pass through its meshes from cath- o plate in the manner already de- d for a diode. However, if the s made slightly negative with re- to cathode, it exercises a repulsive on electrons moving outwards from thode, and some of them are turn- ck.

he grid is made progressively more ve, the repulsive effect becomes er and a condition can ultimately

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1764	"	" " "		
1765	"	" " "		
1766	125	" " "	285—CT—285	5v—2A; 2 x 6.3v—2A.
1767	"	" " "	300—CT—300	
1768	"	" " "	325—CT—325	
1769	"	" " "	350—CT—350	
1770	"	" " "	385—CT—385	
1771	150	200—230—240	285—CT—285	5v—3A; 6.3v—2A; 6.3v—CT—2A.
1772	"	" " "	325—CT—325	ditto
1773	"	" " "	350—CT—350	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1774	"	" " "	350—CT—350	5v—3A; 6.3v—CT—3A; 2.5v—3A.
1775	"	" " "	385—CT—385	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1776	175	200—230—240	285—CT—285	
1777	"	" " "	325—CT—325	
1778	"	" " "	350—CT—350	All in this section
1779	"	" " "	385—CT—350	
1780	200	" " "	350—CT—385	5v—3A; 6.3v—3A; 6.3v—CT—3A.
1781	200	" " "	400—CT—400	
1782	200	" " "	450—CT—450	
1400	250	200—220—230—240	565, 500 425 A side	2 x 6.3v—3A; 2 x 2.5v—3A; 5v—3A.
1371	300	" " " "	1000, 850, 750, 600, 500 A side	— — —

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Valves: As for 921-15.
19% Screen Taps.

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Resp.: 10-50,000 cps.
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19% Screen Taps.

TYPE 916-8: 12 watts.
Prim.: As 916-15.
Sec.: 2 or 8 ohms.
Resp.: As for 916--15.
Valves: As for 916-15.
19% Screen Taps.

TYPE 949: 12 watts.
Prim.: 8000 ohms P.P.
Sec.: 2, 8, 12.5 and 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6V6, 6BW6, KT61, EL84, etc.
19% Screen Taps.

FOR MULLARD "5-10" AMPLIFIER

TYPE 2525 — 12 watts
Prim.: 8000 or 6000 ohms CT.
Sec.: As above.
Response: + — 1 DB 10-100,000 cps.

SPECIAL HI-FIDELITY +—, 1db 20-40,000 cps

OUTPUT TYPE

TYPE 870 — 6 watts.
Prim.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms. (for "Rola" 120X)

TYPE 871 — 12 watts
Prim.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms.

TYPE 872 — 12 watts
Prim.: 10,000 ohms P.P.
Sec.: 3.7 or 15 ohms.

HIGH FIDELITY +—, db 30-15,000 cps

OUTPUT TYPE

TYPE 763 — 15 watts.
Prim.: 5000, 300 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

TYPE 920 — 15 watts
Prim.: 5000, 3000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 897 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 896 — 15 watts
Prim.: 10,000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

T.V. KIT

(Designed for use in TV Circuit. Published by Philips Elect. Ind. P/L.)
P.T. 1790: P: 200, 230, 240V; S: 230-CT-230, 350 mA; F: 2 x 6.3V at 6A.
O.T. 2507: To Philips Specification.
Z 1090; 3 Hys-300 mA Choke, D.C. Res.: 50 ohms.

MATCHED KIT (For Mullard 20W EL34 Amp.)

P.T. 1783: P: 200-230-240v., 50v
S: 410-CT-410v., 180 mA.
F: 5v-3a; 6.3v.-CT-4A; 6.3v.-CT-2.5A (Electrostatic Screen)
Z. 1092: 10 Hys-180 mA Choke; D.C. Res., 200 ohms.
O.T. 921: See above. Tested and approved for use in this Amp., by Technical Service Dept. of Mullard (Aust.) Pty. Ltd.

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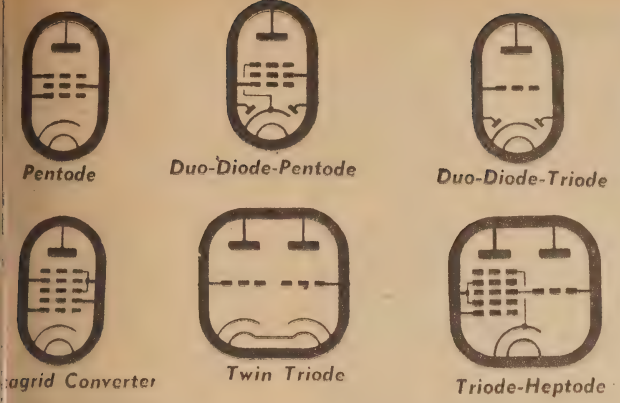


re 9. Schematic symbols for a variety of typical valve types. But variations in schematic representation are often encountered.

valve can receive stations from all the world under favorable condi-

ve manufacturers have provided us special high amplification triodes, with others intended to deliver h power to operate a loudspeaker. are also general-purpose triodes— intended for all classes of ser-

EEN-GRID VALVE

h the rapid advance in radio know- it soon became evident that, not- anding all its advantages, the tri- had definite limitations. And, as designers sought to overcome these tions and to keep step with pro- in circuit design, there came into one new class of valve after an-

r has the process finished even now. ver, whereas attention at first was ew electronic principles, it is now along the lines of achieving the favorable physical and electrical cteristics.

e chief single difficulty with the was the considerable capacitance en the plate and control grid. A thought will show that a condenser must surely exist, because the grid late are both fairly large physically; they are mounted quite close together and insulated the one from the other.

In some circuit applications, this grid-plate capacitance effect did not matter, but in others it caused a lot of trouble and seriously limited the usefulness of the valve.

If we can venture a little ahead of ourselves, it may be said that the grid-plate capacitance caused instability and oscillation in radio frequency amplifier stages.

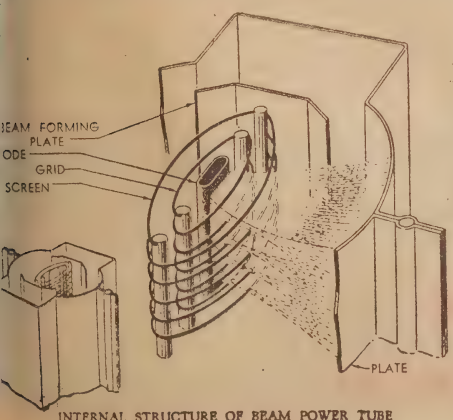
The ultimate answer to this problem was the introduction of another grid between the control grid and plate. The new four-electrode valve became known popularly as a "screen-grid" valve or "tetrode".

Valve designers arranged that this extra grid should be operated at a positive potential somewhat less than that applied to the plate. A bypass capacitor of 0.1 mfd or thereabouts is connected between this SCREEN-GRID and cathode (or earth), so that the screen itself is virtually at earth potential. (See figure 7.)

It thus acts as an electrostatic shield between grid and plate, and reduces the capacitance effect between them to a very small figure. Whereas the capacitance averages 8 mmfd in a triode, the grid-plate capacitance with screen grid or tetrode valve is seldom more than 0.01 mmfd.

Further, to reduce the grid-plate capacitance it became common practice to provide a connection for one or the other in the form of a cap on top of the glass envelope, instead of connecting it to the

(Continued on Page 119)



INTERNAL STRUCTURE OF BEAM POWER TUBE

Figure 8. The electrode structure of a typical beam-power valve, showing how the secondary emission is suppressed.

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MC67	12	7	6		18/-
MC81	10	10	8		£1-1-6
MC811	12	11	8		1-5-6
MC82	13	10	6¼		1-5-6
MC83	13	8	6½		1-5-6
MC79	15	9	7		1-7-6

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MM4 with 3½ x 3½ front 2 13/16 hole. 10/9 plus 12½% Sales Tax.

MM5 with 5 x 5 front 2 13/16 hole. 12/9 plus 12½% Sales Tax.

Sloping Front Cabinets

Cat. No.	Long.	High	Deep	Price 12½ pc	Plus S.T.
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SF8	13	8	8½		£1-4-6
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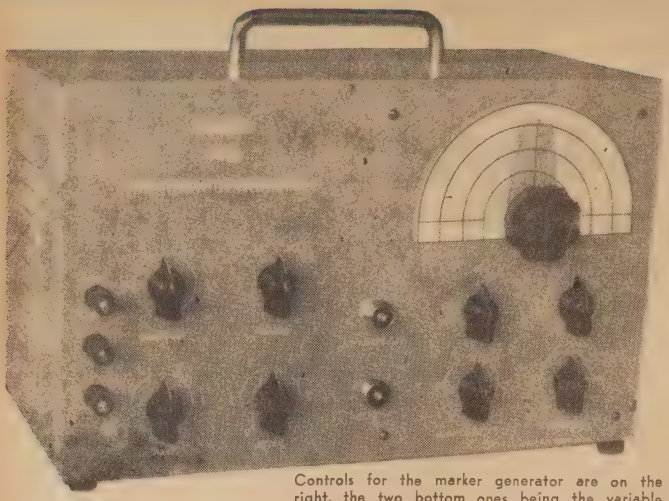


Controls for the marker generator are on the right, the two bottom ones being the variable and crystal attenuators, and the upper ones the band selector and calibration adjustment. The main tuning control is obvious.

The complete instrument as housed in the large RT & H instrument case. The engraved panel not only enhances the appearance, but is virtually essential to identify the various controls. The sweep controls are on the left of the panel, and those of the marker on the right.

A Sweep & Marker Generator Part Two

As promised in the March issue, we give here a description of a marker generator to c with the sweep generator described in that issue. Embodying both variable and cryst oscillators, it enables a high degree of accuracy to be achieved on all ranges.

by Philip Watson

SINCE we produced the, sweep generator several months ago we have had opportunity to try it under a wide variety of conditions, particularly in the adjustment of TV receivers. Having thus put it through its paces we are more enthusiastic than ever about its performance.

It has more than enough sweep for the TV IF band, exhibits consistent output characteristics, and is sufficiently linear for all practical purposes. Further, since there is deviation to spare, it becomes a simple matter to sacrifice some of this to provide even better linearity, should this be required.

Based mainly on the experience gained over the past couple of months we have made a few minor changes, which are worth considering before going on to discuss the marker generator.

MAINS FILTER

A most important one, and which should have been shown in the original circuit, is the by-passing of the mains to minimise RF leakage. As shown, a .01 mfd from each side of the mains to chassis is all that is required. Mica types should be used in this position.

We also substituted a switch with shorting plates to short out all unwanted coils. This is identical with that used in the marker oscillator. It is also physically more suitable and helps to shorten some of the leads. The two contacts associated with the shorting plates should be bridged together and earthed to the switch frame for best results.

As suggested last month, we wound a coil for channel 2 (63 to 70 Mc). In fact, it covers from about 55 to nearly 75 Mc, and will easily cover both channel 7 and channel 9 on the third harmonic. It consists of 3.5 turns of 18-gauge wire, wound in a 4in diameter former, and spread to 5/8in long. The tap is approximately one turn from the earth end.

The coil is self-supporting and mounted between the appropriate switch contacts. The earthy end is returned to the earthing network used for the other coils. (See the March article.)

To improve the linearity of the sweep it is only necessary to load the marker circuit with as much "C" as can be tolerated, which will compress the sweep on the high frequency end of the band where it normally tends to expand unduly.

TWO METHODS

This may be added in the form of a fixed capacitor or, preferably, by increasing the size of the fine tuning condenser. The latter arrangement allows the maximum sweep or best linearity to be selected according to requirements, a maximum of about 50 pf will probably prove about right.

And, finally, there is the question of obtaining the vital mechanical vibrator unit. Fellows who were early in the field were successful, but the supply appears to have dried up rapidly.

Rather ironically, current copies of the English "Wireless World" carry advertisements for these units, which now appear to be in plentiful supply, being selling for the ridiculously low price of 7/6 sterling. A few enthusiasts are considering sending to England for a unit, reasoning that it would still be an economical proposition even with freight and other charges. However, due to the weight, air freight would probably be excessive.

One of the firms is Proops Bros. Ltd., 52 Tottenham Court Rd., London, W.1. Their classification of the unit is AN/APN1 Transducer.

Now we come to the marker generator itself. Basically this is a simple crystal modulated signal generator designed to cover the same ranges as the sweep generator and having about the same coverage for each range. No more than essential coverage is provided on each band, thus providing well-spaced calibrations.

5.5 Mc CRYSTAL

In addition there is a crystal oscillator having a fundamental frequency of 5.5 Mc. This is the sound IF for all 625-line carrier TV receivers. It is determined by the transmitter and is thus always "spot on", meaning that the receiver must be likewise. The only sure way of achieving this is by means of a crystal standard.

Also, by the careful use of harmonics the crystal may be used to check the ranges at suitable spots, thus raising the standard of the variable oscillator. A panel control is provided whereby the variable oscillator may be corrected for minor errors when it is checked against the crystal.

n the variable and the crystal oscil- have separate attenuators, while ystal attenuator contains a switch off the crystal oscillator if it is not ed. The crystal oscillator is mixed ally with the sweep signal, but the le marker is brought out to a panel

This latter arrangement enables ety of external connections to be as dictated by individual require-

whole oscillator is contained in a shield box of such dimensions that y be housed alongside the sweep tor in one of our large instrument By insulating the metal box from main case, other than at a single leakage from the oscillator is well illed.

use, both the variable and crystal tors may be made to produce a r pip on the response pattern. the variable marker is super- ed on that of the crystal the re- t beat pattern, down to zero beat. rly evident and is used as a means cking the variable oscillator.

erence to the circuit will show that strument is built around the new pentode TV mixer valve, the 6U8. pentode section is used for the vari- oscillator, employing a Colpitt's tor in a form of electron coupling. the triode section functions as a e Pierce oscillator for the crystal ard.

CTRON COUPLING

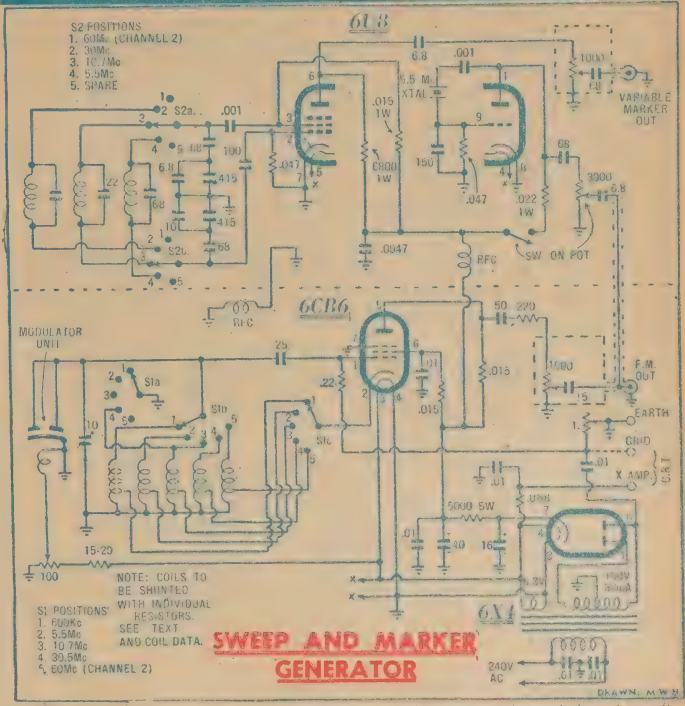
the pentode section the cathode and screen form a triode for the oscillator circuit, while the sup- or serves as a screen between this on and the plate, from which the s taken. Admittedly this is not a electron coupled circuit as usually stood, but it works very well in ce and is perfectly satisfactory for equirements.

table 5.5 Mc crystals are available mercially, or you may be able to find posals type close enough to justify ing. We were fortunate in having on 5.46 Mc (5460 Kc), which we rstand was quite common among sals crystals at one time. It did ake much effort to grind this to the red 5.5 Mc.

vo sizes of crystal holders are nor- employed, one having ½in spacing en pins and the other ⅓in spacing. ets for both types are available com- ially and one should be chosen to he selected crystal.

verting to the variable marker, one ur biggest problems was to find a

CIRCUIT DIAGRAM OF RF SECTION



The lower circuit is the original sweep generator, the top one the added marker unit. Note the filtering of the HT pos. and neg. lines, the earthing of the attenuator circuits, and the mains by-passes in the sweep circuit. The crystal output is mixed internally with the sweep output.

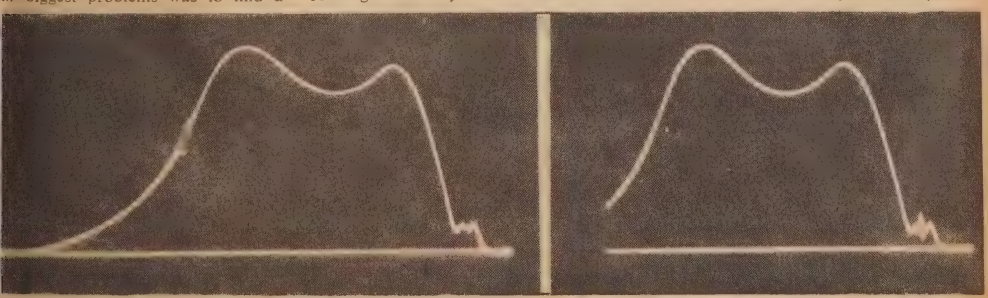
suitable tuning capacitor. We wanted one which would give restricted tuning range in order to spread the dial calibrations over a reasonable distance. At first we had ideas about using the currently available FM tuning capacitors, these seemingly having just about the right capacitance range.

However, stray capacitance in the tuned circuit proved greater than we anticipated, and it was not possible to provide adequate coverage over the vital TV IF range.

Unfortunately, the next step up is to the standard B/C style with a maximum capacitance around 400 pf. As it stood, this was clearly too large, and would defeat our object of giving bandspread coverage. We toyed with the idea of removing plates until the required range was achieved, but a second look at the close spacing of a miniature gang made us think twice.

Another idea was to connect smaller values of capacitance in series with each section of the gang, a scheme which would certainly restrict the range. The snag is that it would also produce a non-linear tuning law, very crowded at one end and spread out at the other.

We finally countered this by using both series and shunt capacitance to restrict the range, the two methods being effective at opposite ends of the range and thus tending to straighten out the tuning law. In addition, by connecting most of the shunt capacitance across each coil, we were able to vary the amount of



o response curves produced by our sweep and marker generator. They were taken from an experimental IF strip and are not cessarily optimum. The non-linearity at the left of the trace can be improved as described in the article. Note the marker pips.

IRC AUSTRALIA

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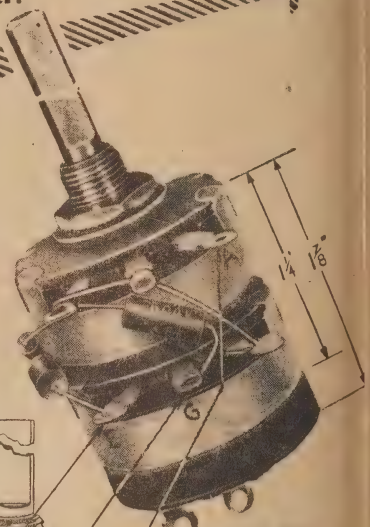
(Patent Applied for No. N11262)



LB1

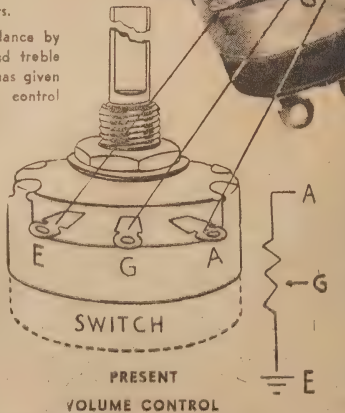
For many years there has been a need for a volume control in audio systems which would automatically keep the proper balance of all frequencies within the audio range at any listening level. I.R.C. has developed such a control, known as the LB1, to meet this need.

With the loudness control it is possible to reduce the output volume of any good or average audio system to a whisper and still be able to hear every tone with perfect balance, as the LB1 **provides gradually increasing high and low frequency boost** as the volume is reduced to offset the deficiencies of the human ear, **which is insensitive to high and low frequencies at low volume.** This accounts for the reason why many audio systems are operated at such high levels to give the best listening effect and in this process they become annoying to other members of the household and neighbours.

Many attempts have been made to obtain correct tonal balance by means of tapped volume controls, various types of bass and treble boost circuits and stepped type loudness controls, but none has given the performance of a truly continuously variable loudness control such as the new I.R.C. LB1.

The I.R.C. new loudness control consists of two separate volume controls operated from a single shaft of standard size and used with a combination of capacitors and resistors which are already wired. The unit will replace any volume control by transposing 3 simple connections, as indicated by the illustration at right. Can be fitted without experience.

Contact your usual supplier for illustrated literature.



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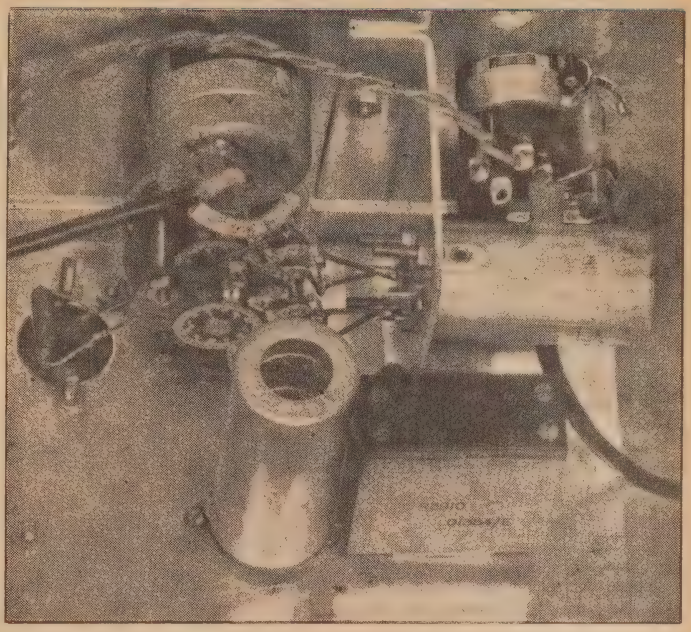
UNDER CHASSIS OF RF SECTION



The underside of the chassis. The 5.5 Mc coil is on the extreme left, the other two on the bracket at right. The 10.7 Mc coil is nearest the camera. The crystal attenuator is on the right, that for the variable oscillator at left. Note the extra shield (old pot. cover) housing the output capacitor.

re for each band; a worthwhile ge where different bands require t orders of coverage.
an be seen from the photographs t is built on a panel and chassis, er being in the form of a shelf d to the panel about half way up. l sub-panel is used to support the coils. Over all is fitted a metal provide the necessary RF shield

whole assembly is fastened to the anel by means of insulated pillars 1in long. The control shaft holes front panel are clearance size, so o electrical connection is made n the two. The switch and pot are long enough for this purpose fine and main tuning capacitor ed extending.

BLE COUPLING

the fine tuning control a simple on shaft will serve, and this may uit the main capacitor. Alter y, an insulated flexible coupling e used, the extended shaft having r bearing mounted on the front This will eliminate any shaft icity, which may prejudice accur l calibration.
ve the chassis is mounted the main capacitor, the 5.5 Mc coil, a al strip to take the incoming fila and HT leads, and most of the components. Both the valve and are mounted upside down with ket connections above the chassis band selector switch is below the and so mounted that the two g contacts pass through holes in inity of the tuning capacitor fixed terminals. Connection to these is via a 68 pf ceramic capacitor in ase.
full description of the switch, as by the manufacturer, is as follows: ion, double sided, each 1 pole, 5 n, with earthing plate shorting all ts except one in use. Distance clicker plate to 1st section. ½in. en 1st and 2nd section, 1in.
same type is suitable for both the and marker generators but, for tter, the distance between decks is educed to ⅜in by modifying the s. It is also necessary to reverse decks (putting the shorting plate t the clicker plate) and render the inoperative. This enables various ts to be brought as close as pos- o their respective connections.

PLACEMENT

5.5 Mc coil (on the main chassis) thest from the switch and uses the contacts furthest but one from oving contacts. The 30 Mc coil is t to the switch and uses the con- closest but one to the moving con- The middle set are used for the Mc coil. The contacts nearest the g contacts are for the 60 Mc coil. will probably be self supporting. forget to bridge and earth the two cts belonging to the shorting plates. e coils are wound on formers simi- those used in the sweep generator. r case the type MO4. In any case, e a type having adjustable iron to facilitate the final setting of the ency range, and make sure that are physically suitable. The coil is given in a panel elsewhere in rticle.

The valve socket is so orientated that the pin gap faces towards the crystal socket and this gives short leads for all the critical components. All leads associated with tuned circuits, which might affect the calibration, are of 18 gauge tinned copper wire, or the pigtails of associated components.

To prevent interaction between the sweep and marker generators, it is important to take certain precautions against energy from one finding its way into the other. In particular there is the possibility of sweep energy finding its way into the marker generator, thence via the marker output circuit to the equipment under test.

When this happens it is invariably found that some portions of the swept band have been favored over others, meaning that the level output which is so essential from the sweep generator becomes a series of humps and hollows.

The following are the points to observe: The filament circuit is earthed only in the sweep generator. The HT line passes through an RF choke housed in the marker generator case, which

PARTS LIST

1 Sub-panel, box, chassis, and coil bracket. (See blueprint)
1 6U8 valve
1 9 pin miniature socket and shield
1 Crystal. 5.5 Mc
1 Socket to suit crystal
3 Shielded coil formers with iron dust cores (MO4 or similar)
1 2 section, 5 position switch with shorting plate (See text)
1 Single contact mic. plug and socket. Types C/1/02M & C/1/01F
2 RF chokes (see text)
2 ¼in. to ¼in. extension shafts
4 pointer knobs MV8 or similar
1 medium instrument knob M1K2 or similar
4 1 in. insulating pillars
PT9M co-axial cable
1 7 tag terminal strip
1 2 tag. terminal strip

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2 .001 mfd mica
1 2 gang miniature approx. 400 pf
1 150 pf mica
1 100 pf mica
5 68 pf (2 ceramic, 3 optional)
1 22pf mica or ceramic
1 10 pf (2 plate) variable
3 6.8 pf mica or ceramic

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1 .015M 1W
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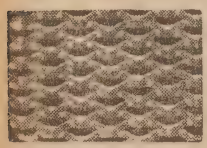

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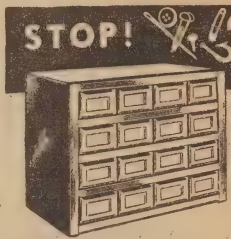
For quickest possible service, write on the left-hand side of a sheet of paper the radio parts that interest you — one beneath the other. If a kit, itemise. Add your name and address and send it to us with a stamped, self-addressed envelope. We will add the latest prices and return to you. Use this sheet as your order form and return to us with remittance for cost and postage as quoted. Goods will be sent same day Any surplus refunded. Sorry, no C.O.D



Model A—Cabinet 12in x 9in x 5¼in 16 drawers 5¼in x 2⅝in x 1¼in .

Mod B 4 drawers 11in x 1¼in
Mod C 4 drawers 5¼in x 3¾in.
Mod. D 8 small and 2 drawers
Mod. E 8 small and 2 drawers
Mod F. 4 small 1 long, 2 drawers.
Mod G 9 drawers 5¼in x 2⅝in
Mod H. As Mod A—but with divisions.
Mod. J. As Mod B—but with divisions

Send self-addressed stamped envelope for illustrated l These all-steel COLRAD craftsman-built handy cabinets, tively finished in baked grey hammertone enamel with vision for fitting identifcation card on each drawer.

A strong and most useful cabinet for holding small pa tools Ideal for mechanic, engineer, garage or home shop Provision is made for stacking into units

OVERALL SIZE 11¾in wide, 9in high 5¼in deep
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- PERMEABILITY TUNED.
- LITZ WIRE COIL.
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- COMPACT.
- PLASTIC CABINET 5in x 3in x 3in.
- THE MIGHTY ATOM.

EXTRAS:—

100ft Aerial	7/6
BROWN'S Sensitive Phones or	49/6
4K17 Disposals Phones	25/-

49/
PLUS 2/
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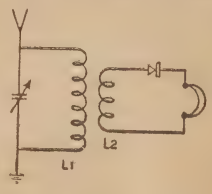
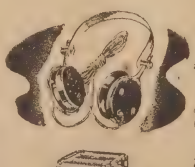


BUILD YOUR OW
CRYSTAL SET

L1—50 TURNS No. 20 E COPPER ON 3IN C BOARD TUBE

L2—15 TURNS No 20 WC OVER CENTRE OF L1. (USE a 4A42 GERMANIU DIODE DETECTOR 10/-)



(CRYSTAL SET PARTS

BROWN'S supersensitive high in ince headphones. Long cords, pow alnico magnet 49/6
4K17 Disposals phones New and Army. Sensitive 25/-
4A42 Supersensitive Germanium I indestructible crystal 10/
Aerial wire, insulated, 100ft.
No. 20 enamelled copper winding for coils, etc. 3d pe
Egg type porcelain insulators 6
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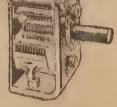
Tuning condenser, 400pf 14/
Midget tuning condenser, 400pf 19/



ALL POST FREE

REMOVED FROM 409 LONSDALE ST. TO 179 FLINDERS LANE, MELBOURNE, C

assed on the marker generator
The negative return lead passes
an RF choke mounted in the
generator. This is not by-passed
her of these RF chokes appears
critical in value, and ordinary
rcial single or multiple pie types
rfectly satisfactory. Note that
lament current does not pass
h the choke in the negative lead.
rving only as a HT return circuit
marker generator is earthed (at
otentials) via the shielding braid
variable marker output cable
nd is earthed at the earthy lug
attenuator pot., which is earthed
frame of the pot., and the other
f the braid at the output socket
front panel.

LE SHIELD

improve the attenuation of the
le oscillator the 68 pf. isolating
tor from the moving arm of the
s shielded. The shield is simply
ver from an old pot., which is
ed to the rear of the attenuator
A couple of lead holes drilled
side and a certain amount of pre
bly enables the job to be done
simply.
attenuator for the crystal oscil
is a miniature 3000 ohm carbon
ith switch, about the lowest value
ally available. The switch breaks
IT line to the crystal oscillator
endering it completely inoperative
this be necessary.
short length of coaxial cable con
the moving arm of this pot. to
weep output socket on the front
where the circuits are coupled.
braid from each lead is earthed
is point, but it was found not de
e to earth the crystal oscillator
at any other point. This helps
inimise leakage of the variable
ator energy.

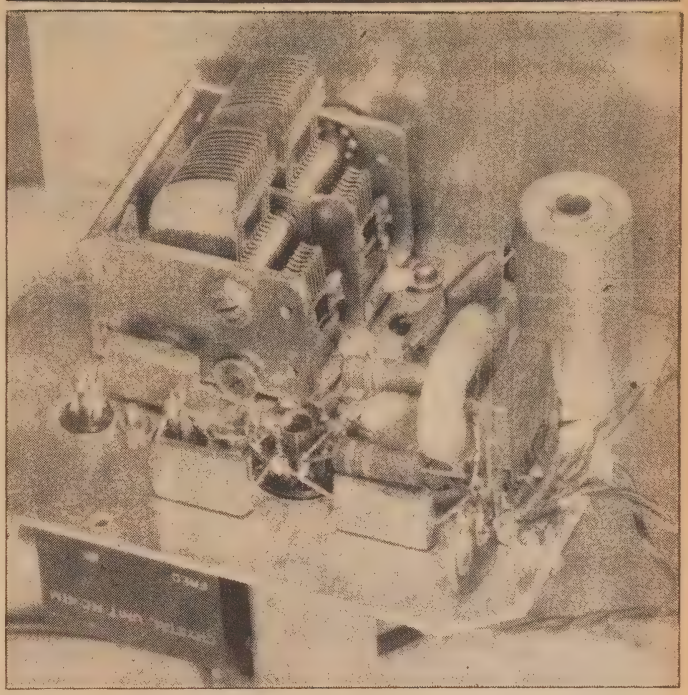
a final check on all these pre
ons we strongly recommend checking
ven output in the manner described
e March article. The only thing
d. in addition to the CRO, is a
e detector circuit using one of the
anium diodes. In our case the
s were substantially the same after
ddition of the marker generator as
e, and readers should have no
ulty in securing similar results.
e remainder of the construction is
straightforward and should not
any bother to anyone with reason
experience.

TS ON USING

w a few points about using this
of instrument. The output from
weep generator is normally fed into
quipment to be checked, such as a
r FM IF channel, and the output
this taken to the vertical deflection
it of the CRO. The sweep input
be to the grid of the mixer, a test
nominated by the manufacturer,
mply capacitively coupled by con
ng it to a metal band wrapped
nd the (unshielded) mixer valve.
the unit has its own detector or
iminator the output may be fed
t to the CRO. Otherwise it will be
ssary to add a simple detector of
e kind. A network similar to that de
ed in the March issue will usually

some cases it may be necessary to
" the local oscillator, but it is better
y tuning or switching it to a fre
ncy which does not interfere. The

MOST WIRING IS ABOVE CHASSIS



Most of the wiring is above the chassis, the valve and crystal sockets being inverted. The coil is for the 5.5 Mc band and in front of it is the terminal strip for the incoming power wires. Note the 68 pf capacitors in series with the gang fixed plates.

local oscillator can sometimes produce a spurious marker pip which may be mistaken for a crystal marker.

Whatever form of coupling is used, make sure that the circuit is not overloaded. This can cause gross distortion of the pattern and, in the case of TV circuits, produce patterns which may appear "perfect", even though the actual response is quite poor.

COIL DATA

WOUND ON 5/16 in. DIAMETER FORMERS WITH SINGLE IRON DUST CORE (MO4 OR SIMILAR)

BAND	WIRE	TURNS	SHUNT "C"
30 Mc	24 SWG	10	By trial
10 Mc	31 SWG	24	24 pf
5.5 Mc	31 SWG	50	68 pf

Changes of shape as the strength of the input signal is varied may be due (apart from overload) to variations within the attenuator circuit of the sweep generator, but are more frequently due to changes within the equipment under test, brought on by combinations of AVC action, Miller effect, etc.

The purpose of the marker generator is to enable any part of the response curve to be identified in terms of frequency. Signals from it are mixed with the sweep signals, producing a thickening of the trace whenever the sweep frequency crosses the marker frequency.

The thickening is actually a beat pattern due to the difference between the two frequencies. The point of zero beat, where the two frequencies are equal, can be seen in the centre of the marker blip. Because it is a difference frequency, the blip should, theoretically spread along the entire length of the trace. The only reason it doesn't is due to the limited frequency response of the amplifier in the CRO.

Where this response is good, the blip may appear very elongated, and is not easy to interpret. Better results are achieved by deliberately wrecking the CRO response by connecting a suitable value of capacitance, determined experimentally, across the vertical input terminals. Use the value which gives the narrowest trace without serious attenuation of the height.

MARKER INPUT POINTS

The marker energy in this instrument is brought out to a separate lead and the usual arrangement is to couple this to the same input point as the sweep generator, using no more coupling than absolutely necessary. In most cases a few "pf" only will be needed but more can be used if necessary.

In some cases it is possible and preferable to feed this energy into the circuit at some point closer to the output point, as for example, the last IF stage. However, care must be taken to see that the adjustment of the tuned circuit is not upset by the method of connection used.

In all cases the important thing is not

(Continued on page 55.)

GOOD RECORDING BEGINS WITH

BASF

Long Play Recording Tape

MAGNETOPHON

TYPE LGS RECORDING TAPE WITH LUVITHERM BA

Eight out of the ten major Recording Studios in Australia use BASF type L.G.S. Tape for the first step in the production of high grade L.P. discs.

3000'	on 10½"	spool	Price on request
1800'	„ 7"	„	95/6
1200'	„ 5¾"	„	65/-
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220'	„ 3"	„	21/-

SPECIFICATION	"STANDARD"	"LONG PLAYI
Width:	0.25" + 0 — 0.004"	0.25" + 0—0.0
Thickness of Base Film:	0.0015"	0.0009"
Thickness of Coating:	0.0005"	0.0005"
Tensile Strength:	7½ lbs. per ¼" width	5 lbs. per ¼" wi
Elastic Elongation:	At 1 lb load, less than 0.5% (1 minute application)	At 7/10 lb load, than 0.5% (1 minute applica

Magnetic Properties: Coercive force approx. 300 Oersteds.
Frequency Response: Recording and playing back frequen more than 15 Kcs at a tape speed of 7.5"/sec.
Modulation Noise: More than 50 db below peak modulati (measured as DC magnetisation).
Basic Noise: From a tape erased in the normal manner is least 65 db below recording level.
Frasure: Under normal erasing conditions more than 65 d
Print: Exceeding 60 db after close contact for 5 minutes

★ SEALED PACK

★ Each tape is individually sealed and fitted with colour leaders (green at beginning and red at conclusion).

★ Each tape metal—striped at the beginning—If you requir it will operate on "automatic stop recorder".

STANDARD TAPE

2400ft	on 10½in	spool	Price on reque
1200ft	on 7in	spool	67
850ft	on 5¾in	spool	59
600ft	on 5in	spool	39
400ft	on 4in	spool	34

BASF

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NTS ON CHECKING RESISTORS

In checking the electrical value of components, your results are not always what they seem to be. Here are a few points to watch concerning resistors.

N TIMES the simpler things one ounters in radio and audio work to get overlooked. For example, ld seem to be quite an easy to check the inductance of a ing choke or the capacitance of trolytic capacitor, with the cor- olarising current or voltage. ever, when one looks around to test instrument to make the sement, it just isn't readily avail- o we are virtually forced into tine of taking things for granted. wish to check as to whether a component is functioning cor- or not, the only available method to be by substitution, using an- omponent of the same type. this proves to be somewhat un- tory, because the results can be usive. We really need to know check the various fundamental ents used in radio: resistance, nce, and capacitance, to varying of accuracy, according to their

TANCE VALUES

simplest method of resistance g is by means of a simple ohm- either an instrument built ally for this purpose or an ohm- range on a volt-ohm-milliammeter. racy of this method of measuring ce rarely exceeds 10 pc and may n be as good as this.

ming that the accuracy of the coil meter used for the instru- s plus or minus 2 pc and that the s used in the instrument are te to plus or minus 1 pc, the cy of the instrument as a perfect rator between the internal and l resistances cannot be better lus or minus 1 pc.

And the accuracy of comparison is only to within plus or minus 2 pc of the full-scale current reading on the scale. If the scale reading, on a voltage or current scale, is compared with the reading on the ohms scale, it will be found that an error representing 2 pc of full scale in voltage or current reading may amount to an 8 pc error in resistance value. This is at the point of maximum accuracy of comparison, between the external resistance being measured and the internal resistance of the instrument.

Thus it is seen that the best accuracy obtainable using an instrument with a plus or minus 2 pc movement and plus or minus 1 pc internal resistance gives a guaranteed accuracy at centre scale reading of 9 pc.

At readings between one-third and three times the resistance value, which is the range one might expect to use before switching to the next scale, the accuracy can reasonably be expected to stay within 10 pc.

With an instrument using lower accuracy components than those used for illustration, the accuracy of the final reading in ohms will be considerably poorer than 10 pc.

From this it will be evident that an ohmmeter can only be used to make a rough check as to whether a resistance is within the preferred value range for which it is color coded—if it is of a plus or minus 10 pc or higher tolerance rating.

To check that the resistance is within plus or minus 10 pc of its rated value, the result is a little doubtful and it is certainly impossible to rely on an ohmmeter reading to check to a tolerance of plus or minus 5 pc or closer.

Although the ohmmeter readings cannot be trusted for checking to close tolerances, it is possible to use an ohmmeter to check for reasonably good matching between pairs of resistors, if this happens to be the requirement rather than close precision in actual value.

As an example, in many push-pull amplifiers the resistors responsible for controlling the gain in the two halves of the push-pull arrangement must be closely matched to ensure balance.

Production values may be specified to 5 pc or even closer tolerances, to avoid the necessity of having to select matched pairs, but the essential feature is that the value of the two corresponding resistors shall be within a close tolerance of one another.

It will not necessarily matter if both of them are, say, 10 pc or 15 pc from their nominal rating, as long as they are within 5 pc of each other. This the ohmmeter is reasonably capable of checking, because it is quite possible to read an ohmmeter scale to within 5 pc.

Since the question as to whether the reading is within 5 pc of its actual value is unimportant in this particular application, the significance of the reading does not matter as much as whether the two resistors which should be matched give readings within 5 pc of one another.

For some applications, however, such as calibrated attenuators or instruments for use in radio, it is necessary to check resistor values to closer limits such as 5 pc, 2 pc or even 1 pc, as the case may require. In these circumstances it is important that the value shall really be within the specified percentage of its rated value. The only method of making a measurement that is satisfactory for this purpose is to use a Wheatstone type bridge, using calibrated elements whose accuracy is better than the required component accuracy.

—Radio & Television News.

VEEP AND MARKER GENERATOR---PART 2

(Continued from Page 53)

any more marker energy than is ely necessary to secure an identi- marker. Excess energy can distort tern seriously, rendering it mean-

e patterns will not produce as marker as others for a given free- rom distortion. FM discriminator irves in particular can be very t. The main reason for this is e circuit is tending to reject the gnal produced by the beat signal, it necessary to use a lot of energy to give even a small pip. rejection is least at the top and of the curve and greatest in the centre. It is sometimes necessary to e a distorted pattern in order ot sh, initially, that the "S" curve is ly centred. Alternatively, meas- nts may be made at the top and of the curve, and the centre fre- taken as being midway between This is only valid if the curve is ly symmetrical.

sound plateau of a TV curve is r point where the marker may not be very obvious, due to the reduced amplitude in this part of the response. It is a help to move the pattern sideways until this portion is near the centre of the screen, and where focusing is generally sharper and astigmatism less obvious.

It must be emphasised that these problems, and others like them, are not peculiar to the RT and H instrument. They are those which will normally be encountered when employing any type of equipment, and are perfectly normal ones associated with this method of alignment. Part of the skill of the job is the ability to differentiate between faulty patterns due to incorrect settings, etc., of the test gear, and those due to genuine faults in the equipment under test.

Once this skill is acquired — and it takes only a little practice — the full value of the instrument, and this method of alignment in general, will be appreciated. Once you have used it you will wonder how you ever managed without it.

Wider Angle TV Tubes

Wider than wide-angle TV picture tubes recently introduced by RCA in America make one wonder if the flat "picture-on-the-wall" display device will really be necessary after all. The tube is a 21in rectangular type (21EP4) and has a diagonal deflection angle as large as 110 degrees (or a line scan angle of 106 degrees).

This has reduced the overall length by about 5½in over comparable tubes with the same size of screen and 90 degrees deflection angles. Another feature is a narrow neck diameter (1½in) which makes it possible to deflect the beam through the extra wide angle with only slightly more power than is required to scan a tube with a 90 degree angle.

An electrostatic focusing system is used to maintain uniformity of focus over the whole screen. Other American manufacturers are following suit with the new angle. (Wireless World Feb. 1957).

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ROM THE SERVICEMAN WHO TELLS

's month, for the first time, I have some TV service stories to relate. As you will see, my st TV service call turned out to be so elementary that I could see little point in relating it at the time. Now, however, I can tell it in its true perspective.

most of us, I suppose, I had ked forward to my first TV job ixed feelings; mostly curiosity, but me apprehension. According to textbooks there seemed to be so weird and wonderful things that wrong with a TV set that I won- ust how I would make out when to a showdown.

ld I be tricked by some queer shift condition in a gated AGC Or a cranky synchronising cir- at refused to synch? Or even aded intermittent made worse by liar surroundings?

e ,and many others of a similar seemed to be the lot of our over- nfreres and, in spite of their re- assurances that it wasn't really as it seemed, I could never look underside of a strange chassis in days without experiencing a mild of dismay.

IBLE WITH TV

as more or less in this frame of when I received my first call; a int that the sound had " . . . a kind of hum in it". To me this mean only one thing—50-cycle buzz which, by some means, was through into the sound channel. ing rather like the medico in the ns, who invariably refers to a copy Home Doctor in the middle of eration, I made a hurried check h available references dealing with articular fault. Then, still not over-confident, I set out.

afraid it came as an awful anti- when I finally switched the set d realised that that the hum was lain, ordinary everyday 50-cycle hum. The "funny" part, which taken to mean the characteristic note produced by the triangular form of the frame time base, was ently nothing more than an ex- on of the owner, to whom any of hum would appear funny.

much for my apprehension and inute reference to the text books. et down was nearly as bad as if ally struck a nasty one.

, of course, I still had to find the

RIMINATOR HUM

rned the volume control down and that the hum went down with it. was ahead of the volume control, nost probably in the discriminator . And from what experience I ad with discriminators in FM sets prepared to take pretty long odds the 6AL5 discriminator diode.

ulled it out of the socket and fit- new one in its place. As the de warmed up the sound came gh again—completely free from I'd picked it in one.

d so my first call came and went almost painlessly. At the same time I had a feeling that there would be a nasty one waiting for me some time.

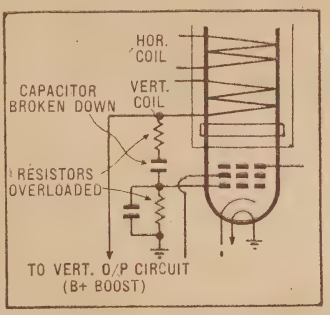
In fact, such jobs as I had over the following months were hardly more involved—or interesting—and it wasn't until quite recently that a really unusual one occurred.

It happened on Anzac Day, and the customer had settled himself down to view the march and ceremony in somewhat greater comfort and convenience than had been possible in previous years. Also he hoped to get a better view than those less fortunate onlookers behind the barriers.

For a while all went well, though the station he chose had some trouble early in the piece when they lost their synch pulses for a brief period.

Then, about half-way through the march, more trouble occurred. The picture started to jitter badly and the owner assumed that the station was in trouble once again. Even when the picture vanished completely he wasn't particularly worried, but simply switched to another channel.

However, when this failed to produce



Relevant portion of the TV circuit showing how a breakdown in the fly-back suppression capacitor caused loss of EHT. The two resistors, as well as overheating, loaded the EHT transformer excessively.

a picture, and the third channel likewise, he began to suspect the set. The last doubt was dispelled when he perceived a wisp of smoke curling out of the back of the cabinet. Wisely, he switched off.

Thus it was that, early the following morning, I received a message to the effect that the particular set had started to go up in smoke. Well, at least I should be able to track that one down, I thought, as I packed some gear into the truck.

At the customer's home, I was told the story of the failure as I just related it. Then I gingerly removed the back, switched the set on again, and stood by to switch off in a hurry should things get out of hand. When, after a minute, there was neither picture, raster or anything else on the screen, I considered it more than likely that the EHT had failed.

Not that this is the only possible cause of such symptoms. Failure of the brightness control circuit, such as to apply excessive negative bias to the picture tube grid, or failure of the picture tube itself, can cause a similar effect.

COOKED RESISTOR

At this stage, speculation was cut short by the appearance of a wisp of smoke filtering through the mesh of the EHT cage. I switched off hurriedly. Then I took a sniff at the smoke. It wasn't the unpleasant and unmistakable smell of transformer varnish, but rather that of charred bakelite. Probably a resistor going up, I imagined.

I got the chassis out of the cabinet and removed the EHT cage cover. Strangely enough the few resistors and other "bits" in this part of the circuit appeared to be completely intact, and I could see nothing from which the smoke may have originated. Then I realised that there was a substantial cable cut-out in the bottom of the EHT cage leading to the underside of the main chassis. The smoke could possibly have come through this opening.

Very gently I turned the set on to its side and inspected the area around the cut-out. In spite of what I was seeking, I was temporarily puzzled by one of the resistors which appeared to be coded with three brown rings. 110 ohms? Surely not.

It took me several seconds to realise that the three rings were only brown because they had been mildly cooked; in this case just sufficiently to change their color without producing obvious blistering.

FLY BACK CIRCUIT

Wouldn't it!

After some tracing of the circuit, I eventually identified the resistor as part of the frame fly-back suppression circuit, running from one side of the frame deflection coil, through a coupling capacitor, to the picture tube grid. In the process I found another resistor with obvious signs of overheating. This was the picture tube grid resistor running to chassis.

In simpler terms, the two resistors and the capacitor were in series between the B plus boost (via the frame deflection circuit) and chassis. Now, if that capacitor had broken down. . . .

The ohm meter confirmed my suspicions. The capacitor HAD broken down and taken the two resistors with it. It had also placed a large positive bias on the picture tube grid. Fortunately there was plenty of resistance in

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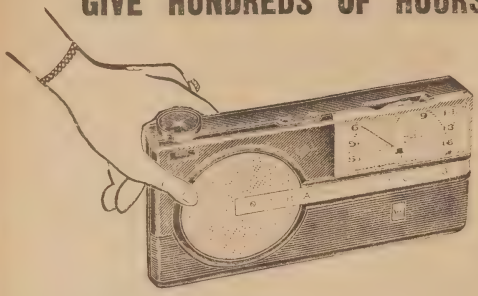

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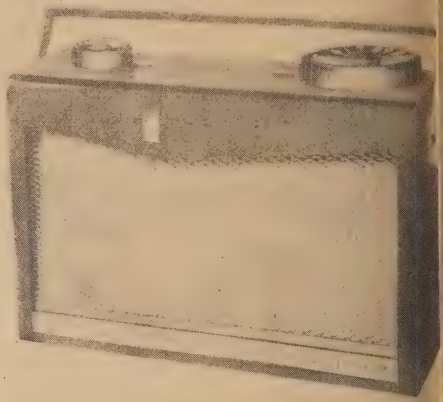

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ode circuit to protect it from any damage.

rs were simple, and I soon had functioning again, much to the the owner, who was convinced was nothing less than the picture I have noticed that owners in jump to this conclusion, regard the symptoms. Undoubtedly the tube will take the place of the hich is invariably suspect in the a sound receiver.)

ore immediate interest is the exact why the fault caused a failure EHT voltage. I had worked out y while I was patching up the but I confess I needed to make er check of the manufacturer's liagram before I could be sure it rect.

OF EHT

is fairly obvious that the break- ould throw a heavy drain on the oost circuit, since the frame de- coil was connected directly to lus boost in the output circuit of me amplifier. More particularly d this resistance (amounting to 0,000 ohms in all) across a por- the EHT transformer where. ably, its damping action was suf- o prevent the fly-back surge from ng the normal EHT voltage. ow much it reduced the EHT I now have no means of know- t it was certainly enough to wipe ure off the screen. So there it is. "unusual" TV fault

next story is on a completely dif- but more familiar, theme, namely nge amplifiers. In this case it was -made Playmaster No. 2, and the while he could follow a circuit ke a good job of the construction. pelessly lost when something went

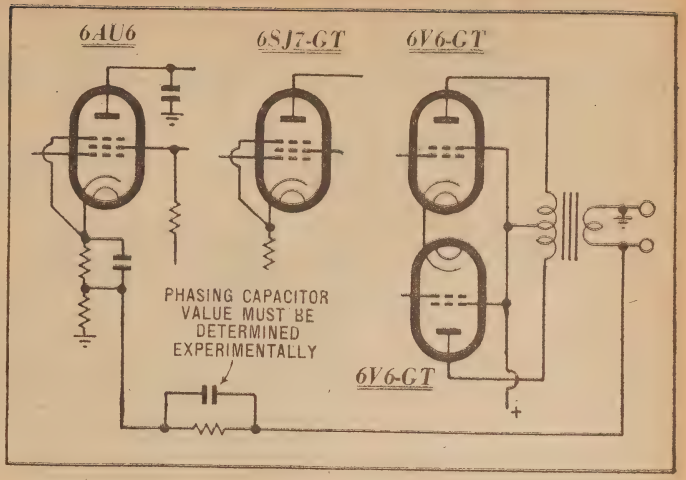
s given to understand that the unit rformed quite satisfactorily since been built a couple of years back until a few days ago, when it ddenly "dropped its bundle"

amplifier was used in conjunction ie No. 2 Control Unit and one Wide Range Tuners; altogether nice combination. The trouble mmon to both tuner and pickup so I suggested that the whole ly be brought in for checking.

ER OF WATTAGE

st checked the main amplifier and oved to be OK in sensitivity, so ed to the control unit. It didn't ong to discover that there was few volts of HT and this was aced to the 2000 ohm decoupling in the main amplifier. This was att type instead of the recom d 5-watt, and it just couldn't take nishment which had been meted it over a period of many months as now a mass of badly charred e with something like 10 times ginal resistance. Small wonder o auxiliary units protested. A new r. of suitable rating, quickly re- the original performance all

t done, it occurred to me that uld be interesting to check the mance on the square wave gene- In particular, I was anxious to w it compared with more recent s in terms of square wave per- nce, since this method of testing ity just being developed when the Playmasters were produced.



Skeleton circuit of the No. 2 Playmaster Amplifier, showing the feedback circuit and the addition of the phasing capacitor across the feedback resistor. Its value is fairly critical and generally has to be determined experimentally.

More correctly, it was the output transformer, and its suitability for this type of circuit that I wished to check, since it is the transformer which is the major limiting factor in the overall performance of such amplifiers. To make matters more interesting, the transformer was one of the cheaper types intended mainly for PA systems. Its maker had never intended that it be used in circuits of this kind, though in some cases it was possible to get away with such liberties.

RINGING

The two most likely effects of using unsuitable transformers in conjunction with complicated feedback networks are super-sonic oscillation and "ringing" In fact, the second effect is only a variation of the first, it being the condition which prevails when the degree of positive feedback is insufficient to maintain steady oscillation, but is sufficient to cause damped oscillations to be generated by the shock of a steeply rising wave front

Of the two, this latter effect is the more insidious, since it can be present without being readily detectable. Straight out oscillation will generally show itself in one form or another, and can frequently be detected with nothing more than an output meter. Ringing, on the other hand, will generally remain hidden through all the more conventional tests, including the display of a sine wave on the CRO.

Since it needs a steeply-rising wave front to produce the condition, the ordinary sine wave tests are valueless, and something more like the complex waveforms encountered in practice are necessary. The square wave represents the most extreme case that can ever be encountered, since the wave front is virtually perpendicular. An amplifier which does not ring under these conditions is just not capable of ringing.

At the present time there does not seem to be any general agreement as to what order of ringing can be tolerated or as to what might constitute a reasonable compromise between absolute performance on the one hand and cost on the other. As a result, the general approach seems to be that of doing the best job possible in the hope that it is good enough.

The best transformers which have been produced so far are capable of extremely good results, and it is doubtful whether anything better would be necessary Unfortunately, such transformers are not cheap (though plenty of fellows seem happy to buy them) and it is difficult to know how far performance—and cost—could be reduced before the final result would be seriously prejudiced.

Nevertheless, it is not difficult to pick cases which are extremely bad or extremely good, and I, for one, am quite content to experiment along these lines until some more learned bod makes a definite pronouncement about the in-between conditions.

So I set the gear up on the bench and proceeded to feed audio signals into it at various frequencies. After some preliminary fiddling and a rough check on frequency response—using sine waves—I set the generator to 5 Kc (a figure generally regarded as being most useful for this kind of observation) and switched to square waves.

BEAUTIFUL PATTERN

And what a pattern it produced on the CRO screen! It must surely rank as a classic in the field of ringing amplifiers. Had I set out deliberately to produce an "horrible example", I doubt whether I could have done better. But now, since it had appeared, I was determined to record it for my readers.

Ever since I had watched a friend photograph some CRO patterns for a previous article (September, 1956), I had been intrigued by the possibilities it offered. It seemed to me that, with the advent of TV, there would be many occasions when I would want to record such phenomena for the benefit of readers. Since I couldn't always call on someone else to do the job, I would have to learn to do it myself. (Furthermore, it provided an excellent excuse to buy myself a good camera.)

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y my hand at the game, so I put
ob aside until next day so that I
have the camera on hand. I wont
you with technical details, but suf-
it to say that I obtained several good
es. Two of these are reproduced
ith.

te particularly the nature of the
g pattern. It is an almost perfect
ple of a damped oscillation, and I
if you will find a better one in
extbook. It is easy to appreciate
the sudden change in level repre-
d by the vertical portion of the trace
tes the oscillation which, being un-
to maintain itself, slowly dies away
at the end of the horizontal trace.
is almost ceased. Then another
e in level starts the whole thing
again.

is also possible to make an esti-
of the frequency involved by ob-
g the number of cycles relative to
undamental. In this case there are
nine cycles to one cycle of the
mental and, since this latter is 5
he ringing is at about 45 Kc.

K

will invariably be found, if one's
ator will cover the range, that there
be a noticeable peak in the response
is ringing frequency. So it was in
case, there being a definite rise
nd the 45 Kc mark.

ot all cases are as clear-cut as this.
etimes there are several minor peaks
an equal number of ringing fre-
cies, making a pattern which is very
to interpret and a condition which
t always easy to cure.

lt, simple or complex, the cause is
rally the same, namely, using output
sformers having unsuitable charac-
tics in circuits which include this
sformer in the feedback loop. While
an arrangement has several advan-
s, particularly in extending the fre-
ncy response of a transformer and
ing out irregularities in its response
e, it also has its problems.

hese concern the matter of phase shift
veen the primary and secondary
dings, whereby a connection which
s maximum negative feedback at one
uency may give less negative feed-
at some other frequency, and even
legree of positive feedback at yet
ther frequency.

is not hard to visualise what would
pen if the phase of signal in the
ndary of the transformer was com-
ely reversed at some particular fre-
ncy. Instead of so many db of nega-
feedback, we would have a similar
er of positive feedback. The result
ld be hopeless oscillation at this fre-
ncy.

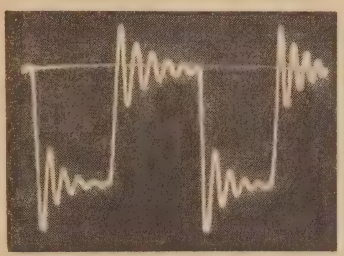
RYING DEGREES

t is seldom the phase reversal is
plete, but it is often sufficient to
g on sustained oscillations. Alter-
vely, it may bring about a condition
re the amplifier is on the verge of
illation, but can't quite make it. When
happens a sudden shock will set it
illating, but, because the amount of
dback is insufficient, the oscillation
not be maintained and will rapidly
away. This is the condition shown
he photograph.

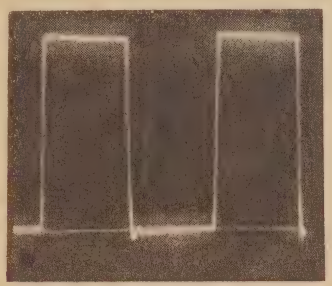
Next question is what to do about it.
easiest approach—as long as it is
neone else's amplifier — is to say,
row the transformer out and buy a
ter one". Which is all very nice—if
can afford it!

A more practical approach is to try modifying the circuit in some way which will minimise the effect without seriously sacrificing performance in other respects. One suggestion is to simply reduce the amount of feedback, and this is often very effective if the condition is only moderate and the amount of feedback high.

In fact, as has been pointed out on many previous occasions in other articles, many enthusiasts often kill the goose that lays the golden egg by piling on



Before! The ringing pattern produced by a 5 Kc square wave. It is a near perfect example of this phenomenon.



After! The change brought about by the simple fitting of a phasing capacitor, as explained in the article. The amount of ringing remaining is negligible. (Photos by Your Serviceman!)

feedback ad infinitum. Even with the best transformers there is a limit to the amount which can be tolerated. Furthermore, the improvement is not a linear function. The first few db provide the most benefit, the effect decreasing as the amount is increased.

A third possibility, and the one I chose to try first, is the fitting of a phase correcting circuit in the feedback loop. In its simplest form—and the one in which it is usually found—it consists of a suitable value of capacitance shunted across the feedback resistor.

As the name implies, its function is to produce a counter phase shift which will correct that of the transformer; just that, and nothing more. If it did just that, it would cure our trouble without any further complications.

Unfortunately, we cannot avoid introducing another effect immediately to fit this capacitor, since its presence across the feedback resistor must reduce the total impedance of the combination as soon as its reactance becomes comparable with resistor. As a result, the feedback is increased with increasing frequency from about this point upwards.

Since we cannot separate these two characteristics, we often find that, in order to completely stabilise a particular system, we have to attenuate the high frequency response more than we would like.

Such a condition occurs with the cheaper type of transformer, such as this one, and which may have a marked phase reversal in the region between 30 and 50 Kc. By the time we have corrected this condition, the increased feed back at rising frequencies has begun to encroach on the audible section of the spectrum or, at least, in the lower supersonic region which many authorities claim are necessary for accurate reproduction.

Better quality transformers are generally classed as such, not so much because they eliminate phase reversal, but simply because it is made to occur at a much higher frequency, say 200 to 300 Kc in a typical case.

(Admittedly, the degree of positive feedback usually appears to be less in these cases, but this may well be due to the limitations of the amplifier, which, even in the best design, would be showing some loss at 200 Kc.)

By shifting the trouble spot so far from the audio spectrum we are now able to take whatever corrective measures we like without fear that these are going to wreck our audio and moderate super-sonic response curve.

More difficult is the extreme case where the transformer design produces, not a single phase reversal effect at (say) 200 Kc, but a number of lesser effects in the same region, or higher, all of which call for correction. Correcting phase reversal at several frequencies in a simple feedback loop is virtually impossible.

For this reason, most enthusiasts prefer a transformer which has a single phase reversal effect as high in the frequency range as possible.

ADJUSTING COMPENSATION

Reverting to the job on the bench, I grabbed an assortment of small value capacitors and went to work. Maybe I was lucky, but it did not take me long to find a value which brought about the condition shown in the second photograph. While some overshoot is still in evidence; it is negligible, compared with the previous condition.

Naturally, I tried to remove even this small amount, but this could not be done without severe rounding of the square wave, representing a loss of essential high frequency response. In other words, the condition illustrated represents an excellent compromise between the two conflicting requirements.

At this point I should be able to quote the exact value of capacitance used. Unfortunately, what with my determination to obtain good pictures of the results, I completely omitted to note this. I do remember that I had a group of values between about 10 and 150 pf, and that a couple of these in parallel were eventually selected. It was probably somewhere around 200 pf.

Fortunately, the exact value is of little importance, because each case has to be determined experimentally. There are too many variable factors to allow a particular value to be specified for a particular circuit.

But the point is that this sometimes-neglected phase (no pun intended) of feedback circuitry can be extremely useful, either to make a poor transformer good, or a good transformer better. It may not work in all cases, of course, but it's certainly worth trying.

NEW R.C.S. UNITS for "R & H" 17 inch TV

COMB. VIDEO-IF & SOUND STRIP

Part No. 554
Price £5/15/-
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INCREMENTAL TUNER

Part No. 55
Price £3/13/
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DETAILS Combination Video---IF. Sound Strip consists of 5 video IF's., 2 sound 5.5m/cs. IF's and 1 ratio detector mounted on combination cadmium chassis, all holes punched. Circuit and details supplied. IF. set at correct frequencies.

I.F. STRIP

Part No. 551
Price 65/-
(plus tax)

5 Video IF's and Traps mounted on Cadmium Chassis, all holes punched. 1 Circuit.

SOUND STRIP

Part No. 552
Price 50/-
(plus tax)

2—5.5m/c IF's and 1—Ratio Detector mounted on cadmium chassis, all holes punched. 1 Circuit..

Incremental Tuner

Part No. 553 Price 73/4 (plus tax)

1 Cadmium Bracket, all holes punched.
1 Video Coupling Transformer.
1 - 2 Bank by 3 Position Switch with 6 Coils mounted.
1 Concentric Fine Tuner Control.
1 Circuit.

The new unit system developed by R.C.S. makes building a TV set almost as easy as a mantel radio. The final chassis is made up of 8 cadmium plated plates, each 8in x 4½in, containing 2, 3 and 4 tube circuits. Each unit can be fully wired and electrically tested in two hours before the units are assembled together. Tube required, 5½in—6in C.R.O. Later rearrange Time Base units and convert to 17in.

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Part No. 77	3H 300ma	Price 20/-
Part No. 76	15H 60ma	Price 14/-
Part No. 80	2.5v 1.75 amp 5Kv. insula.	Price 26/8
Part No. 61	4.0v 1.0amp 5Kv insula.	Price 26/8
Part No. 62	6.3v .6amp 5Kv. insula.	Price 26/8
Part No. 63	Frame Output Trans. 6BM 8.	33/4

All prices plus tax

Part No. 200	Sound IF	Price 11/4
201	Ratio Detector	19/4
202,203,204	Video IF's	11/4
504	4 Pin Coil Assembly	4/8
505	5 Pin Coil Assembly	
534	Coil Dope and Core Sealing Lacquer	3/- per bot.
408	Aer. RF Choke C.T. 2uH	3/4

Prices quoted are Trade Prices—subject to sales tax

Part No. 11	Aerial Filter Kit	Price 140/-
19	½amp Line Filter	50/-
20	¾amp Line Filter	47/-
26	¾amp Line Filter with condensers	53/-
22	5amp Line Filter with condensers	90/-
24	2amp Line Filter	56/-
27	2amp Line Filter with condensers	65/-

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HOSE MISUNDERSTOOD SIDE-BANDS

radio technicians and amateur radio enthusiasts must at some time or another have had or a number of our pet, misdirected theories let us down during a crucial test or argu- nt. The schooled tradesman might very well blush were he confronted with only a few of his examination 'howlers'.

By C. N. HELMRICH

ING a four year period
service in the radio in-
ional field I was acquain-
ith many a startling mis-
ption while inflicting my
brand of reasoning upon
upils.

widely varied bunch, they
commonly bound by a
er of misconstrued ideas
must have their roots in
ot always perfect techni-
of me and my fellow-
ers.

this article I hope to
dy one of the more com-
of a bracket of usual pit-

ulation and sideband radiation
e the most commonly misunder-
and awe-filling subject in radio
g. It receives an almost kid-glove
by inexperienced and many ex-
ed radiomen alike, who suddenly
er that they do not understand as
as they should about the matter.
article has been designed to
ine the fact that the subjects,
ation and side bands, are as insep-
as their association is inevitable.
pupil's very first introduction to
ude modulation usually begins
n entirely correct but very often
misleading statement.

RST POINT

example, it would be quite proper
that in amplitude modulation the
pe of RF oscillation varies with
nplitude of the transmitted intelli-
Full marks, but still meaningless
uninitiated, who, for the moment,
perhaps see the transmitted intelli-
as a corset-bound carrier.
next quite harmless, though very
statement usually offered, is that
agnitude of the amplitude variation
e AM wave can be expressed in
of the degree of modulation or
lation percentage.
at makes everything quite simple as
readily understood. However, it
y allows even the dullest student to
e the transmitted carrier comfort-
housed in its cosy envelope.
ving thus decided that modulation
sy, our budding Marconi listens
ly to the analysis of a modulated
and determines to remember that

$$m = \frac{Emax - Eo}{Eo} \quad \text{or} \quad \frac{Eo - Emin}{Eo}$$

The next subject related to modulation is side bands and when confronted by the usual horrifying formula, consisting mainly of "sines", "co-sines", "pi", etc., most of which break fresh ground the stunned class is usually only too willing to agree that the transmitted energy is made up of three, separate radiated frequencies. The truth is that they believe they understand modulation and reason that the sidebands are represented by the envelope pattern.

(Note: After three attempts to set Mr. Helmrich's original formula on a standard linotype, our perspiring compositors gave up. Unfortunately, it just can't be done.—Editor.)

From the outset it must be realised that the enveloped R.F. pattern can be produced only by mixing the carrier and the upper and lower side band R.F. frequencies. The enveloped waveform is produced by the actual transmitted frequencies.

It is, perhaps, unfortunate that when explaining modulation it is common practice to start at the end in order to begin at the beginning. It is not entirely unavoidable and is very misleading. Also misleading is the modulated envelope pattern produced on the screen of a CRO monitoring the output of an AM transmitter or the input of an AM receiver. Again it must be stressed that the CRO pattern is the result of mixing three radiated frequencies.

Side bands and amplitude modulation can be simply explained in the following way.

Modulation is a system employed to transmit intelligence via the radio frequency spectrum. Having already determined that a continuous wave R.F. signal can be transmitted and received it is now necessary to determine how intelligence in the form of an audio frequency can be converted to R.F. in order to be radiated through the same medium.

(2) NON-LINEAR MIXING

It will be remembered that when two signals of unlike frequency are applied to any one-way conducting path, such as the thermionic valve, there will be produced frequencies not only of the two input frequencies, but of their sum and their different frequencies, e.g.:

500Kc/s
, 1Kc/s—Mixer—500Kcs, 1Kc/s,
501Kc/s and 499Kc/s.

In the case of a CW and an AMCW transmitter the output tank circuit is tuned to the carrier frequency, 500Kc/s in the above example, and only the 500, 501 and 499Kc/s frequencies would appear. The modulating, audio frequency 1Kc/s, would not appear across the tank circuit. Should the modulating frequency remain constant at 1Kc/s the transmitter would continue to radiate three separate, constant radio frequency signals, viz., 500, 501 and 499Kc/s, which when mixed and detected in a receiver would produce 1Kc/s audio note. If the modulating frequency was varied, as would be the case if a microphone was used as the modulating source, the sum and difference frequencies would vary, e.g., supposing the modulating frequency varied between 10C/s and 2Kc/s, the sum frequency would vary between 500,010c/s and 502Kc/s and the difference frequency would vary between 499,990c/s and 498Kc/s.

(3) ABOVE AND BELOW

The sum and difference frequencies are known as the carrier's side bands. The former is called the upper side band and the latter, the lower side band.

Side bands and amplitude modulation is a very large subject. I set out to remedy the common pitfall, and as I have observed that all other aspects of amplitude modulation systems and technique are generally readily understood, the foregoing should put any victim of the pit well enough into the picture to extricate himself.

Ultrasonic soldering of Silicon & Germanium

FLUXLESS ULTRASONIC soldering of silicon and germanium for diodes and transistors provides adherent electrical contacts to these heretofore troublesome metals. When fluxes are used to achieve such contacts, it becomes difficult to achieve the desired low joint resistance due to flux interference.

Contacts as small as 1 millimeter in diameter, having low resistance at temperatures down to 196 deg C, have been produced on silicon with a Sonobond 12-watt generator made by Aeroprojects Inc., West Chester, Pa. In addition, small or thin wafers of these metals can be tinned or soldered to tinned copper wire for transistor work without damage from ultrasonic vibration

PART TWO

Wiring details for

- **The video detec**
- **The video amplif**
- **Synch. separat stage**
- **Frame oscillato and output st**
- **The line oscillo**
- **Line output sta**
- **EHT rectifier supply**

OUR 17-inch TELEVISION SE

Here is the second of three articles describing the construction of a complete 17-inch tele vision receiver. This month we give detailed instructions on wiring up the picture circuitry from the video detector up to, and including, the EHT cage.

IN the first article, we reviewed the overall design and gave sufficient constructional information to allow a start to be made on the project. By completing the tuner, IF amplifier, audio system and power supply as described, it would have been possible to reach a stage where television programs could be heard, if not seen.

As we pointed out last month, we are keen that constructors should follow this line of approach. It helps to spread the cost, it gives practical results early and it allows one to deal at the outset with the more familiar problems.

If the power supply and audio system are wired first, they can be checked tentatively for hum level, tested with an audio input signal, then passed over as virtually finished.

The IF amplifier can then be installed—or perhaps built—and any alignment problems tackled while the chassis is uncluttered by other components. The same remarks apply for the tuner and AGC system.

By continuing the process, it is possible to check each new stage or circuit, as it is added, right through to the picture tube.

There is one point about this, which we omitted to mention last month. If the power supply is operated with less than the total drain imposed, the output voltage will naturally be rather high.

We countered this difficulty in the prototype receiver by wiring an ex-disposals 300-ohm heavy-duty resistor temporarily between the transformer HT centre-tap and earth. It was mounted, in fact, on the chassis until completion of the picture-tube circuitry made it no longer necessary.

By using an odd resistor or choke in this way, the filtered HT voltage can be kept somewhere near the requisite 285, both in the interests of the filter capacitors and operation of the stages under test.

by **Neville Williams**

Since the May issue appeared, we have been able to c plete the requisite chassis blueprints. The larger one s details of the chassis and brackets, the smaller one deta the EHT cage. Chassis made to these specifications sh be obtainable by now but, if you plan to make your own blueprints are available from our office for 12/6 the two.

Whether you buy the chassis or make your own, m sure that it is well finished. Steel will need to be plate well lacquered or finished in hammertone.

Aluminium, which should not be less than 16 gauge, be chemically etched or, as in the prototype chassis, giv matte finish with the finest grade of emery paper. By rub each surface in one direction only and removing finger m before each new component is mounted, a very accep finish can be preserved.

Care along these lines is well w while, because the finished receiver not look better than the chassis on w it is built.

In most cases these remarks will in plenty of time because we antic that few readers will as yet have an actual start on building the rec

Before going on to discuss the pi tube circuits in detail, we suggest you turn up the main circuit dia given last month and make to it a amendments and additions. These mostly draughting details which escaped our notice in rush to get the diagram through on time for the May is

The 0.5 (or 0.47) mfd 400V AGC bypass capacito the tuner should be endorsed "tubular". It is not a cer as might be inferred from the adjacent note.

Just underneath, an "off-on" switch symbol shoul added in the primary circuit of the power transformer. mentioned in the text, this switch is part of the comp Volume-Brightness control.

VIDEO DETECTOR AND AMPLIFIER

s photograph shows the video de-tor at the bottom left corner and peaking chokes added to the pre-ricated IF strip. The video ampli-r socket is at the approximate cen- of the picture, with the tagstrip rrying the AGC and audio de-mphasis components just below it.

lso in the power supply, the main fil- choke should be marked 1 Henry, 3. The unit pictured in the chassis 1 Henry type.

ver on the other side of the diagram the word "VOLUME" to the control he grid circuit of the 6BM8.

milarly, the control connecting to pin f the picture tube can be endorsed CUS", while the 500-ohm pot. in the 7 cathode can be marked "CON AST".

the 12BH7 frame oscillator, the arity components marked 2.2 and 2.5 ld have the suffix "M" to denote ohms—a rather obvious omission.

some copies of the magazine two acitor values in the 12AU7 grid cir- were blurred. They are both .01mfd. inally, in the retrace blanking circuit necting to pin 2 of the 17HP4B, the acitor shown as .47 should be mfd.

ooking now at the rest of the cir-ry, one of the points which most im-ses is the large number of wiring ponents required—a common feature TV receivers. The constructor will rally wonder about using compon- which may already be on hand.

RIETY OF PARTS

hat we have done so ourselves is ly evident from the photographs. ts coming from whatever source was t handy during the months the re-er was under development.

)ne-watt resistors appear in the photo-iphs in some positions where the cir-t specifies only half-watt types. Elec-ally this is not significant, the import-thing being that the rating be not less n that specified.

Whether you buy all new components get what you can where you can, only u can decide.

From talks with supply houses, we her that they may well be able to r a keener price and better supply on ts ordered as a kit, than on equivalent ponents bought on a purely random is. This should be considered in ching a decision.

Concerning parts on hand, they should be used indiscriminately, just be-se the value on the label happens to the same as specified in the circuit.

Particularly does this apply to wartime tubular capacitors, which ill often be found to have develop-d high leakage and power factor. o use these in time-constant and oupling circuits is asking for rouble, quite apart from the diffi-ulty of accommodating their extra ulk.

Large old-style resistors are like-e a poor proposition, because they are bulky to fit conveniently into some tions of the receiver.

Against this, however, many items of posals equipment did contain large mbers of small resistors, which are te usable. The important thing is

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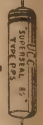

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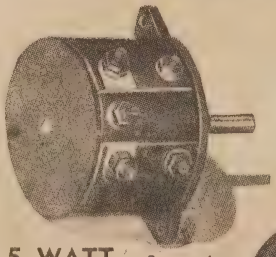
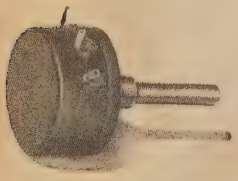
AGN

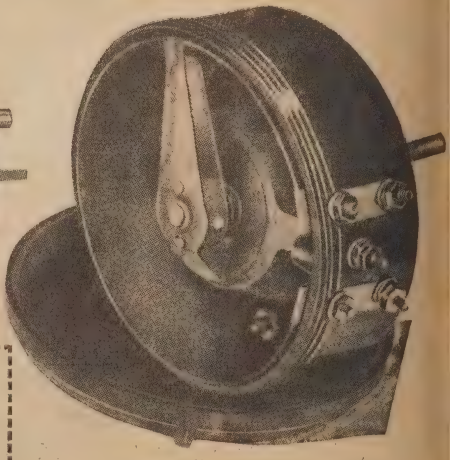
PRECISION
WIRE WOUND POTENTIOMETERS



● **1 WATT** Totally enclosed ⅜in single hole mounting. Size 1⅝in x ¾in.



● **5 WATT** Semi enclosed, Two mounting lugs 2¼in centres. Size 2in x 1⅛in.



● **10 WATT** Totally enclosed, Two tapped mounting holes 2⅞in centres. Size 4in x 1¾in.

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nove and inspect them carefully and eck each one for value on an ac- ohmmeter, before wiring it into

rying on now with the construc- of the receiver, the first step is to ete the wiring around the video or, adding the requisite peaking s.

eceiver will give quite passable pic- without any peaking chokes what- but those specified—two each for ideo detector and amplifier — are worthwhile in terms of ultimate e detail.

e theory and adjustment of peak- okes was discussed at some length ly, in connection with our new scilloscope and cannot be repeated in any detail.

NT CAPACITANCE

e basic problem is that shunt cap- ce between earth and the signal ts reduces the response at the upper frequencies. It is normal to keep ode and video plate loads quite low inimise the influence of shunt cap- ce but, with practical values of loss is still likely to become evi- above about 2 megacycles.

e inclusion of selected chokes in with the respective load resistors s the resultant plate load imped- to rise with frequency as the shunt itive reactance falls. By balancing ffect against the other, the net load e video detector or amplifier can aintained more nearly constant over ater range of frequencies, with a quent extension of the pass band. ain, by connecting selected induc- values in series with the signal path. arious capacitances associated with path can be broken into two groups a series-resonant condition establish- etween the choke and the termin- capacitance. By locating this res- ce point correctly in terms of fre- cy, a further useful extension of ass band is possible.

L VARY WIDELY

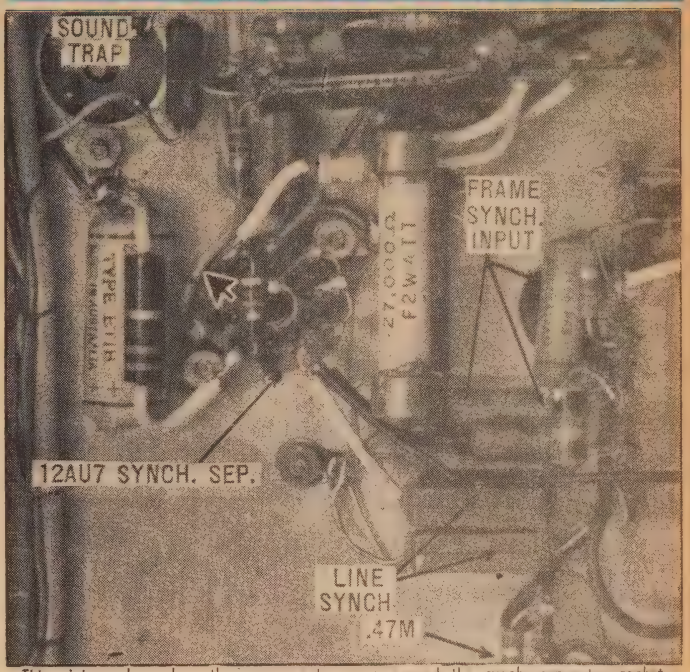
follows from these last two para- hs that the optimum value for ing chokes depends largely on stray citance and this will vary from one ver to another. Values which are wide of the mark may have little ficial effect or, alternatively, may uce prominent resonance peaks in pass band and/or "ringing" effects he picture.

ne values shown in the circuit can egarded as "safe". They follow com- cial practice and have been shown ave a beneficial effect in this par- ar layout without approaching the ing condition. At a later date, when e receivers have been built, it may lesirable to revise our ideas of "aver- ' values but, in the meantime, those ified should be reasonably close to mark.

hose pictured in the original under- h photograph were made up in our laboratory, using the resonance hod to set the inductance. (See page of our last issue.)

he windings came from discarded iature IF transformers, windings be- pushed together where necessary, stripped of turns till the requisite in- tance was obtained. The cardboard ner was trimmed short and slipped

THE SYNCH. SEPARATION STAGE



This picture shows how the components group around the synch. separator socket The two mica capacitors at the bottom right feed the line oscillator. The integrating network to the frame oscillator is above them.

over a high value 1-watt resistor. The winding ends were then soldered to the resistor pigtails and the whole lot sealed up with coil dope to produce a convenient and reliable component.

As it happens, at least one manufacturer has since released a range of peaking chokes in 20 pc "preferred" values and you can use these instead of making your own. Three of the chokes shown in detail photographs are of this type.

They are color coded in the standard RMA manner. Color dots are read in the order: Long end of former, coil edge and coil side, signifying the first two significant digits and the number of noughts following them.

EXTRA COMPONENTS

In the circuit diagram given last month, we marked with an asterisk the chokes and other small components which need to be added to the "Q-Plus" prefabricated IF strip. The detailed photograph reproduced here shows their actual disposition in the unit. Note that the 15uH choke mounts directly between the 6AL5 socket and the tagstrip, the original lead being removed.

Some similar arrangement could obviously be used in a home-built strip.

The detector output lead runs to the end lug on a 7-tag strip alongside the IF strip and thence directly to the grid pin of the 12BY7 video amplifier.

Simple AGC is picked up from the junction point via two resistors, bridging to adjacent lugs on the strip. These lugs are bypassed directly to ground and leads run away to AGC points on the tuner and IF amplifier. From the lug feeding the tuner, a lead runs across also to the 6AL5 clamp diode.

As mentioned last month, the audio de-emphasis components are mounted on the other end of the same tagstrip.

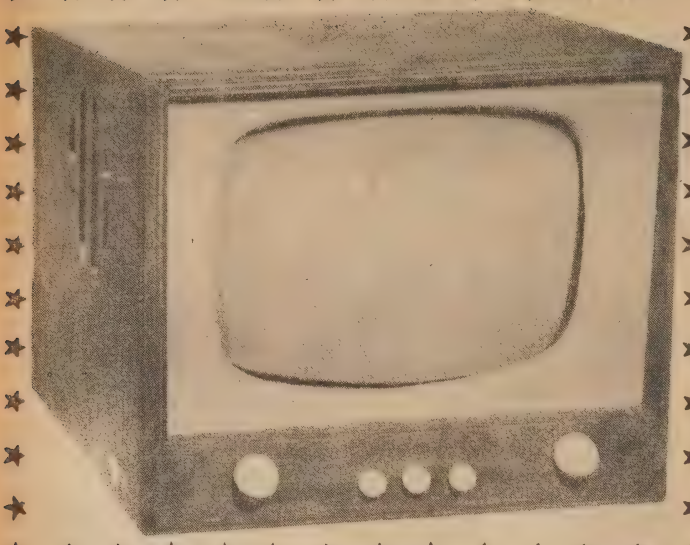
The socket for the 12BY7 video amplifier, as also for the 12AT7 synch. separator, is a wafer type, used mainly because they happened to be on hand. If other type sockets are used, they should be mounted to bring the pins to the same general positions, even if it means drilling new mounting holes. The blank pin position is marked in each case on the photographs.

Heater, grid and suppressor wiring for the 12BY7 require no special comment. The cathode, however, runs to ground through a sound trap and then a 500-ohm potentiometer. This last is mounted on a bracket beneath the centre of the chassis and operated from the front of the receiver by an extension shaft.

SOUND TRAP

To make up the sound trap you will need a miniature coil can and former with variable iron slug. The winding consists of 6¼ turns of 22 B&S gauge enamel wound about 3/8in from the bottom of the former.

The prime purpose of this trap is to produce degeneration and a loss of video gain at the 5.5Mc intercarrier beat, thus minimising interference with the picture. However, it is possible to derive signal from this point to feed the sound IF



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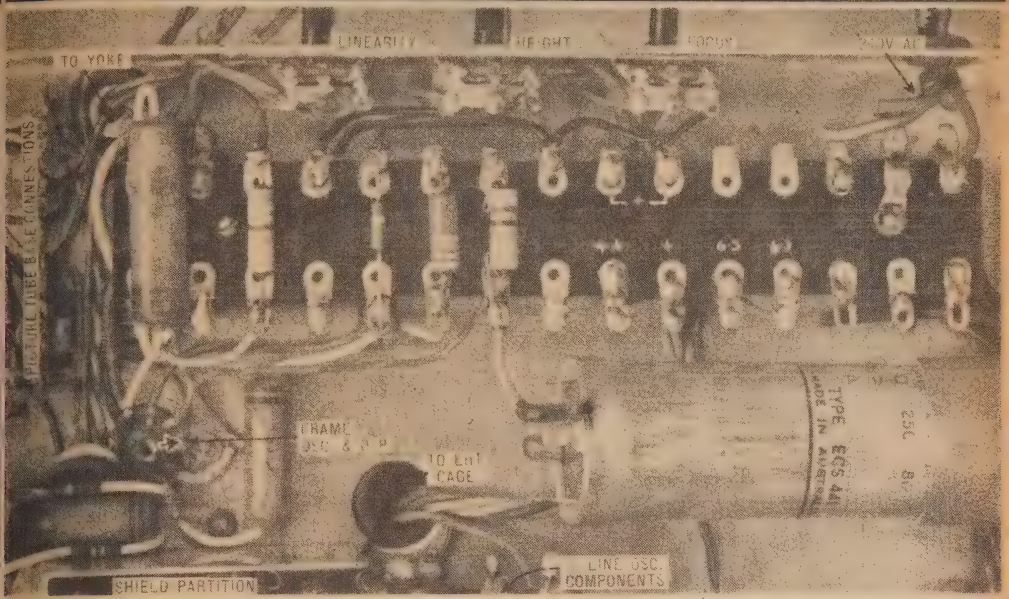
FRAME OSC., OUTPUT AND RETRACE SUPPRESSION



The frame oscillator, frame output and retrace blanking circuits are grouped mainly to the left of this picture. Note the two adjacent lugs on the panel marked with a plus sign, which terminate the wires from the link in the deflection yoke socket. The wiring is arranged so that no HT can reach the cage unless the yoke is connected.

nnel, and a tuned secondary is shown ted with this possibility in mind.

n the "Q-Plus" IF strip, the signal taken directly from the detector but layout of the RT&H receiver is such t the alternative scheme can readily adopted.

Several components in the 12BY7 out- circuit are mounted on the 8-tag p adjacent to it.

The tag point at the end nearest the 3Y7 provides the junction between 47uH choke and the 3300-ohm re- or. A 22K resistor feeding the synch. arator also attaches to this point.

The next lug is "earthy" and the next in provides a junction for the above- ntioned 22K, the .33M and the 270pF acitor for the synch. separator. ese last-mentioned components bridge oss to the fifth lug, the .0022 capacitor upling back to the fourth lug and nce to the 12AU7 synch. separator l.

PLUS POINT

The sixth lug is for plus-285, pro- ing a feed and anchor point for the K plate resistor and the 22K screen istor. Then follows another "earthy" , the final one on this strip pro- ing a junction between the 0.5mfd eo output coupling capacitor and the uH peaking coil.

The 0.5mfd coupling capacitor should rest against the chassis but should suspended at least 1/8in away from The position for the screen supply stor and bypass are apparent from the otograph.

All connections to the base of the ture tube terminate on a second 8-tag ip seen in the same photograph and suitably identified.

Leads to the picture tube pass up through a grommeted hole and extend, in the original set, 14 inches to the picture tube socket. This is sufficient to allow the set to be tested conveniently, standing on the transformer edge, behind the cabinet.

For neatness, the leads can be enclosed in large diameter spaghetti tubing, except for the cathode connection, which must take its own course away from the others, to avoid unnecessary capacitance.

SYNCH. SEPARATOR

From the video amplifier, portion of the signal is diverted to the 12AU7 synch. separation stage and the wiring arrangement is evident from the detail photograph.

The integration network feeding the 12BH7 frame oscillator and the differentiating components to the 6SN7-GTA line oscillator also appear in this picture, being termiated at the 7-tag strip to the right.

The lug nearest the bottom is he junction point for the 82 and 12pF capacitors and, from it, a lead runs across to pin 4 of the 6SN7-GTA socket.

The lug just above it provides the junction for the 22K and 10K resistors forming the integrating network, the 10K bridging to the adjacent lug. These two points are bypassed to earth by small tubular capacitors, as specified.

From the end of the 10K resistor a .01mfd tubular bridges past the "earthy" centre lug of the tagstrip to lug 5, which thus becomes a termination for one lead from the frame blocking transformer, an 82K and a lead from the .47M resistor the Frame Hold circuit.

This resistor, incidentally, is mounted across a 3-tag strip, right at the bottom of the picture.

The remaining two lugs on the 7-tag strip relate to the frame oscillator, which has yet to be discussed. However, for the sake of identification, lug 6 provides an anchor for the .05mfd tubular from pin 1 of the 12BH7, a 2200 ohm resistor running from this point to the earthy centre lug.

The end lug forms an anchor point where the 2.2M resistor from pin 1 of the 12BH7 joins a lead from the 2.5M Frame Linearity control.

Further details of the combined frame oscillator/output stage appear in the appropriate close-up photograph.

We took the precaution here of using a mica-filled moulded socket and avoiding any contamination of the socket by soldering paste. This is justified by the fact that a peak of about 1000 volts appears at the frame output plate.

SHIELD PARTITION

Another point is that a small shield partition has been placed between the frame socket and the wiring to do with the line oscillator and control. Because the actual grid pin of the frame oscillator is raised to a fairly high impedance by the frame transformer, line pulse energy can be coupled into it. It may then trigger in sympathy with one or other of the line pulses which are coincident with the frame block, thus compromising or eliminating the interlace.

Other than those already mentioned, most of the components to do with the frame circuitry are attached to the resistor panel seen in the detail photograph. Because of slight rearrangements in the wiring, this panel has more positions than are now strictly necessary and

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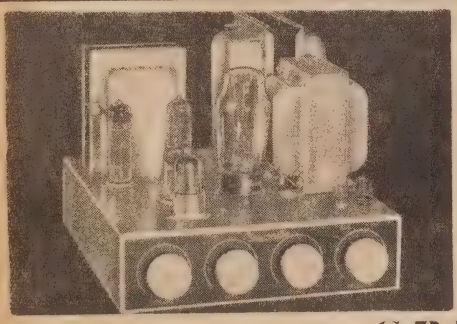

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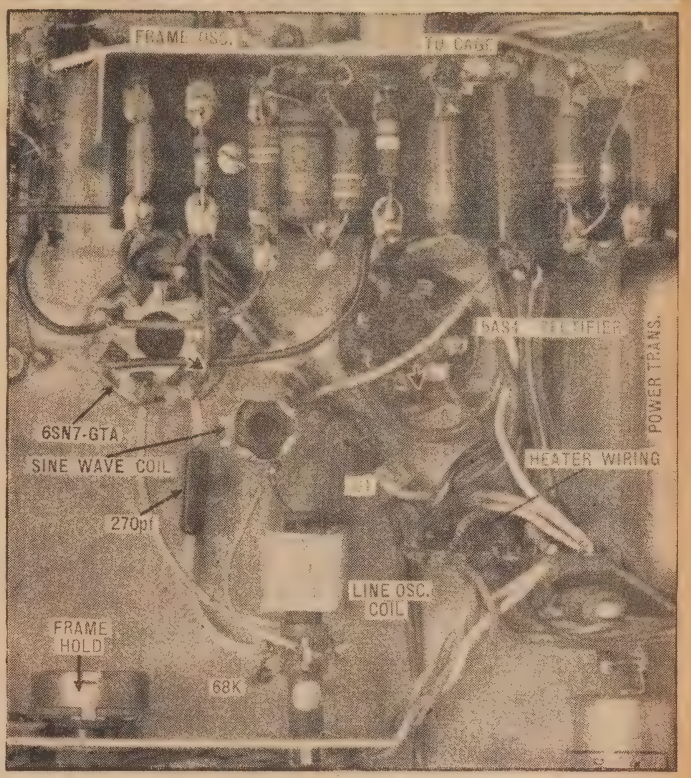


The line oscillator socket is at the left with the relevant components on the panel at the top. The horizontal blocking oscillator coil is at the bottom.

with fewer lugs could conceivably
ed.
wever, as a general guide, the lay
s shown can profitably be detailed.
pair of lugs on the extreme left
e panel are considered as "1", the
nder can be counted off as 2, 3, 4.
from left to right.
gs 1 and 2 on the side remote from
ame sockets are terminal points re-
vely for the yellow and red leads
the frame output transformer. From
same two lugs, a couple of twisted,
nsulated leads run through a grom-
l hole in the chassis to make ulti-
connection with the deflection yoke.
om the yellow lead a .047mfd capa-
bridges to the number 1 lug adja-
to the socket; a wire runs from this
to one end of 3300 ohm resistor,
ing across the two number 3 lugs,
emote end of the resistor linking to
icture tube grid on the nearby tag-
This is the frame flyback suppres-
circuit, made desirable by the use
C coupling in the video amplifier.

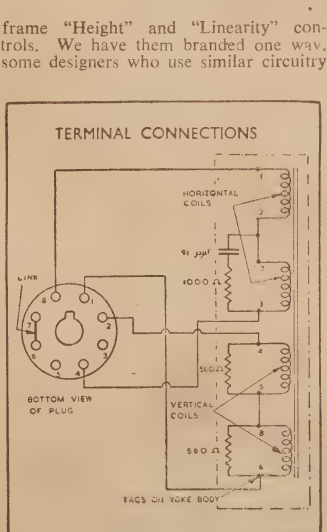
ACITOR VALUE

mentioned earlier, this suppression
ator should be .047mfd, as pictured,
.47 as shown in the circuit. Be-
of the high voltage present, it must
a working voltage rating of not
han 600.
red in this way, the capacitor and
or are transposed in relation to the
it, but this point is not significant
actice.
e number 4 lugs now serve no useful
se, but the number 5 lugs provide
rt for the 2.2M resistor in the grid
it of the frame output tube. The
closest to the socket is linked direct-
pin 7 of the 12BH7 and a 0.1 mfd
itor swings from this same lug back
e oscillator plate, pin 1.
e other end of the 2.2M resistor con-
to the centre lug of the 5000-ohm
ght" control.
ross the two number 6 lugs is a
resistor, one end of which is earthed.
the end closer to the 12BH7
t, a .05mfd tubular bridges directly
e frame output plate, pin 6. This
itor should ideally be within 10 pc
ince and have a high voltage rating
gh, in practice, it may be difficult
cate readily anything higher than
t 600-volt working.

RESISTOR

e number 7 lugs carry the 470-
bias resistor. One end is wired
to cathode and is bypassed to earth,
ther end connecting to the "Height"
ol. There are two points of note

e cathode bypass is specified as
fd and operates with about 55 volts
s its terminals. As originally photo-
hed the receiver had a couple of 50-
150VP pigtail electrolytics connected
arallel and wired to the now vacant
alongside the bias resistor.
en a single 50mfd will do in an
gency but we found that each in-
e in capacitance made a marginal
ovement to the linearity at the ex-
e bottom of the picture. In the
l photograph we show a 250mfd
V can type, which does the job
y but is probably more expensive
strictly necessary. This is one of
oints which only supply and demand
clarify in the way of an optimum
ponent.
he other matter is the function of the frame "Height" and "Linearity" controls. We have them branded one way, some designers who use similar circuitry do the opposite. In actual fact the two controls are highly interdependent, affecting both properties of the display. They have to be adjusted, in consequence, to produce the best result, terminology notwithstanding.



Reprinted from Radiotron TV1 booklet, this diagram shows the interconnection of their yoke with the octal coupling socket.

Reverting to the resistor panel, the remaining lugs are used purely as convenient termination points for the wiring. Thus, at one end, the incoming power cable terminates on three lugs, the opposite lugs anchoring the primary leads from the power transformer. A 4-wire twisted lead running to the "Off-On" switch bridges the respective "Common" and "240" connections.

TO EHT CAGE

Clearly marked also are anchor points at which the 4-wire cable from the EHT cage can be terminated. These include two 6.3 leads, one of which is earthed, a plus-285 and a B-plus boost.

Directly opposite are two lugs marked with a plus sign. One of these is connected to the normal plus-285 line throughout the receiver; the other links to the plus-285 supply point for the EHT cage just mentioned. No high tension should reach the cage unless the two lugs are in some way joined together.

The Radiotron deflection yoke has leads terminated in an octal plug, but a couple of spare pins are intentionally

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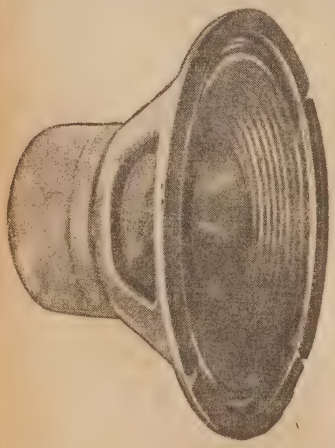

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ed. By running a twisted pair from oke socket to the two lugs marked ", the high tension circuit to the cage will only be continuous when oke is attached to the receiver. is simple precaution obviates the of the line output valve and EHT former being operated without load possibly causing damage, due to ex- e peak voltage.

good quality socket and rear cover esirable to connect the deflection s and B-plus link from the receiver e plug on the deflection yoke.

The numbers shown on our circuit e those given by the AW Valve for their yoke and are not the tual pin numbers on the connect- socket.

ie interconnection between yoke and et is shown in the accompanying dia- extracted from the Radiotron l" booklet. The frame output trans- er must be wired to pins 1 and 2 ie plug and socket in the prescribed r, the line output to pins 4 and 8 the link to pins 6 and 7.

T INTO YOKE

ie tappings and components shown e the dotted border are part and el of the yoke assembly and need concern the constructor.

iis brings us to the last major sec- of the receiver beneath the chassis e line oscillator — the components wiring being shown in the appropri- photograph.

ie 6SN7/GTA requires an octal et, which should be oriented as n, to bring the oscillator pins close he blocking oscillator coil. This r is mounted on a bracket in the re of the chassis, along with the me Hold" and "Contrast" controls, h have already been discussed. djustment of the line oscillator core es, in this circuit, as the "Line Hold" rol. It is supplied with a bakelite lding shaped to receive the core w at the rear and knurled at the front ct as a subsidiary control knob.

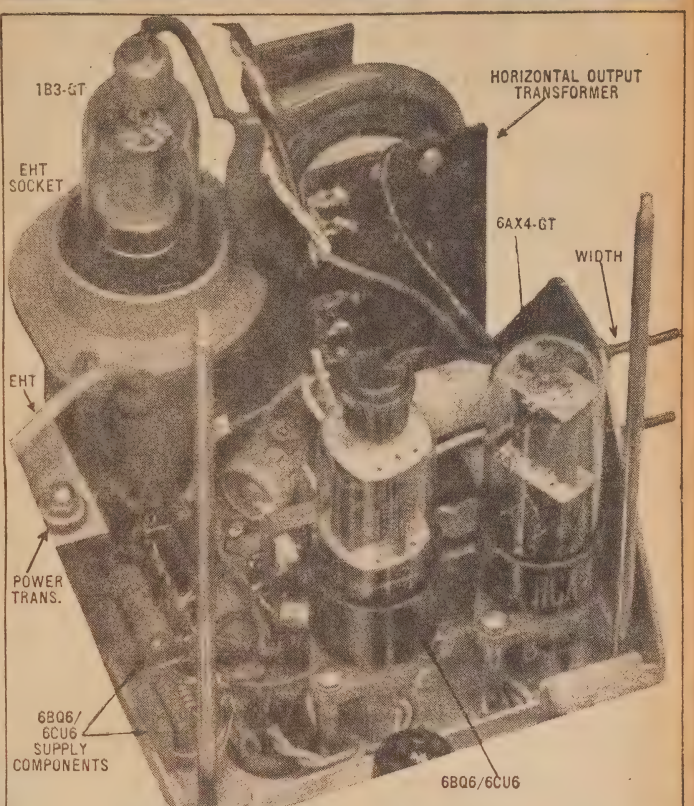
is rather difficult to use the coil his way without having long leads, h may or may not be a good thing home-built receiver. We therefore to work with some brass scrap and ddering iron and made up a gadget e suitable to the RT&H chassis lay- You may care to do the same, or work out a method of adapting the vementioned moulding.

E HOLD CONTROL

. tube of rectangular section was first up from scrap brass, fitting loosely the head of the core adjustment and at half-inch longer than the total el of the core. A scrap of ¼-inch neter brass rod was filed to fit into end of the tube, the two pieces then g lined up, sweated together and shed smooth.

o avoid placing strain on the core, shaft was not carried straight through he control knob. Instead, it was ten with a spring coupler and the t section locked in the chassis by ns of a bush and a couple of circlips, ained from old potentiometers. A -running control results which allows operator to feel easily when the core reached either extreme of its travel. he control is not a particularly robust but it seldom needs to be touched. e the set has been put into operation.

WIRING INSIDE THE EHT CAGE



A general view of the EHT cage, which is constructed as a complete sub-assembly, connected to the main chassis by four bolts and four wires. The disposition of the smaller components, not clear in the picture, is explained in the text.

The line blocking oscillator coil and the sine wave coil just nearby have one-hole mounting clips which grip when the coil is pushed firmly into place. The hole needs to be about 5/16th diameter and must be free of burrs.

The sine wave coil can be adjusted from beneath the chassis or from above, even when the chassis is in position in the cabinet. Some designers alternatively pre-set the blocking oscillator coil and use the sine wave coil for the "Line Hold" circuit follows the maker's recommendation in this respect.

Connections to the two coils, along with other components in the deflection kit are set out in the Radiotron Booklet TV-1 and intending constructors would be well advised to obtain a copy of this. (Amalgamated Wireless Valve Co. Pty. Ltd., 47 York St., Sydney; price 3/- plus 6d postage.)

As seen from the photograph, the 270pF grid capacitor swings between the valve socket and the coil, while the 68K resistor mounts directly on the coil across the appropriate terminals. The .01mfd, which should ideally be a low tolerance mica type, likewise mounts directly to the terminals of the sine wave coil.

All other wiring components are mounted on the resistor panel seen near the top of the picture. Again, for the sake of identification, the lugs at the left of the panel can be numbered "1", progressing through 2, 3, 4, 5, etc., to the left.

The capacitor between the number 1 lugs is the 12pF mica which feeds the line output pulse from the output transformer back to the plate of the synch. separator. The line carrying this pulse runs from the grommeted hole leading to the cage, straight to the capacitor and thence across to pin 6 of the 12AU7 socket. This latter lead is clearly visible.

GRID RESISTOR

The line oscillator grid resistor mounts between the number 2 lugs, the one nearest the valve socket connecting directly to pin 1.

Between the number 3 lugs is the .33M input grid resistor, with the end nearer the socket bridged to pin 4. The other end connects to the .05 (or .047) capacitor, running across to lug 4

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the socket and thence to the
athode pin 6.
this point, a 68K bridges to
furthest from the socket, the
resistor shown in the circuit
ng between the adjacent lugs 3

.22M resistor, .02mfd capacitor
7mfd capacitor associated with
tion of the circuit mount respec-
etween lugs 5, 6 and 7 on the
Lug 6 furthest from the panel
ded. so that the 3900 ohm re-
n series with the .47mfd capaci-
simply bridge between it and
acent lug 7.

ng the panel is quite a tricky
the constructor would be well
to sketch it out and check
the circuit before going ahead.
ip can most easily be wired out
chassis.

number 8 lugs carry the 68K
esistor for the oscillator, the
nd .15M feedback components
linked in obvious fashion be-
his and the two number 8 lugs.
d carrying the line drive voltage
to lug 7 nearer the socket and
up through the grommeted hole
EHT cage.

OUTPUT

ndicated by the circuit diagram,
output valve and all associated
components are housed in the
ove the chassis.

photographically rather difficult
w clearly all the components in
e but an experienced constructor
be able to work things out with-
much trouble.

components are assembled on to
plate measuring 6in x 5in, with
ur edge turned up to provide a
ng for the horizontal Linearity
idth coils.

perforated metal cover 6 3/8in
lips over the whole assembly,
to give access to the adjustments
back and with a hole at the top
e line output and EHT leads to
rough.

mounting pillars for the cover
ade by sweating 1/8in brass rod
3/16 diameter tubing and thread-
ends. The pillars were locked
baseplate and enough left pro-
underneath to pass through the
chassis. The cover slips over the
the pillars and is held in place
ir nuts.

OR COMPONENTS

is a purely mechanical problem
u may prefer to vary the method
yourself.

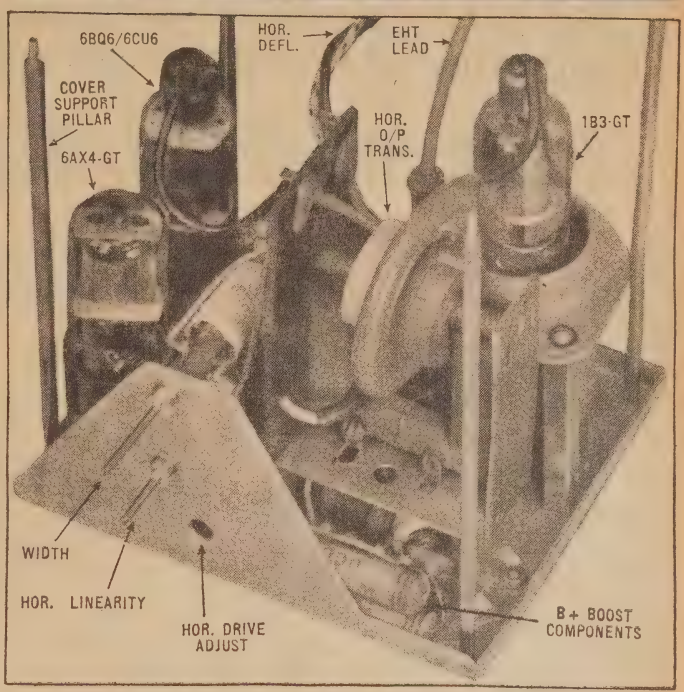
position of the major com-
s should be clear enough from
otographs. The line output trans-
mounts in one corner, with the
rectifier alongside it.

the rectifier we used a special
voltage skirted socket, which is
ed on pillars to bring the skirt
e socket about ½in above the
. This is the "proper" compon-
use but we would not be at all
ed if a high-quality moulded
mounted on insulating pillars
not serve the purpose.

a-filled sockets are suggested for
e output valve and damper diode,
being mounted on about 1in pil-

Horizontal Drive control is a
high-capacitance mica compres-
capacitor, which needs to be

ANOTHER VIEW OF THE EHT CAGE



Another view of the EHT cage, seen from the opposite corner. The components at the bottom of the picture, underneath the line output transformer, are those connected with the B-plus boost circut.

mounted on a small bracket and adjustable from the rear with a long screwdriver. The Linearity and Width coils simply push into 5/16in holes, although it is wise not to mount them until most of the other wiring is complete.

Wiring the cage is a little more complicated than other portions of the receiver, because everything is above the baseplate. The work can be completed, however, before the unit is mounted on to the main chassis.

THE CIRCUIT DIAGRAM

Because of space limitations, the main circuit diagram given last month could not be repeated in this issue. A few minor corrections and additions are noted at the beginning of the article and should be made to your copy of the circuit to prevent possible confusion at some future date.

The wiring parts to do with the line output valve centre mainly on a 8-tag strip seen in the foreground of the first picture.

The sawtooth drive voltage is brought to the end lug, near the corner of the unit. From this point, the two .001 mica capacitors bridge respectively to lugs 3 and 4. (Lug 2 is earthed.)

From lug 3, a .47M resistor bridges back to lug 2, while a wire runs away to the drive capacitor, whence the 47-ohm grid stopper bridges to the grid pin on the 6BQ6.

Lug 4 connects to cathode. From this same lug, the 220-ohm bias resistor runs to the earthed lug 7, while the screen bypass capacitor also returns to it.

Lug 5 is the plus-285 anchor point and the 12K resistor bridges from it to lug 8, which is connected to screen. In the absence of a 12K 2W resistor, two 22K or 25K 1W resistors can be pressed into service, connected in parallel. Lug 6 is a spare.

SEPARATE STRIP

The 250 and 110pF capacitors in the pulse line can be mounted conveniently on a separate 3-tag strip alongside the damper diode.

A third tagstrip mounts the small components to do with the B-plus boost. In the original, it was an 8-tag type with the outer lugs trimmed off and can be seen in the second photograph tucked in underneath the line output transformer.

Lug number 1, nearest the damper diode is earthed, but lug 2 joins to connection 1 on the line output transformer. The two .047 mfd capacitors

(Continued on page 79)

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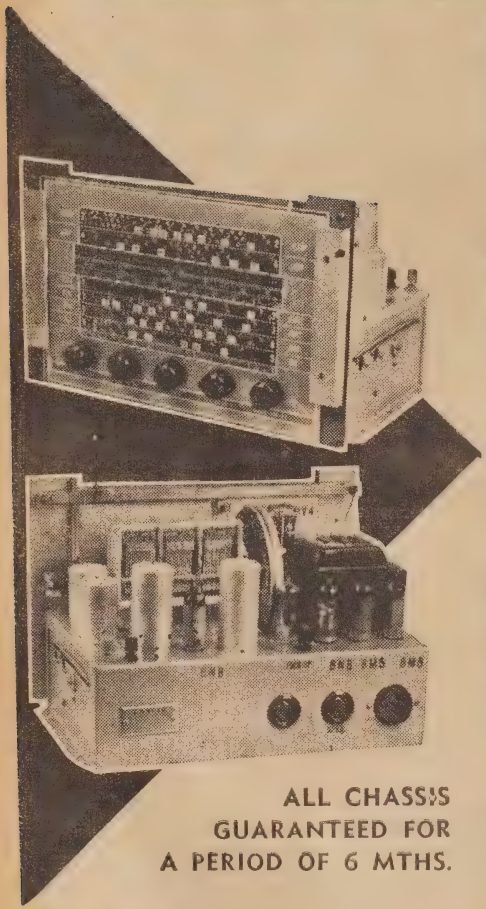

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Ultra modern circuit using nine high gain valves including "m eye" tuning indicator. Permatuned iron cored coils and i mediates giving excellent interstate reception and a short range of 12,000 miles. All valves used are the new Philips pin innoval series.

NEW:

Tone control and audio stages incorporating the Mullard amplifier circuit with separate bass and treble controls givin or — 15db. boost or cut at 50 cycles L.F. and 10,000 cycles combined with push-pull output with inverse feed-back gives really high fidelity reproduction from your radio or favorite re ings.

NEW:

Dual speaker combination using a heavy duty woofer (12in M Jensen AU54 special) with matching 6in tweeter and cross network giving a frequency response of 46 to 13,000 cycles. Spe are mounted coaxially making only one 11in mounting hole n sary.
If required the new Magnavox high fidelity twin coned speake be supplied.

NEW:

Large calibrated edge-lit dial in plate glass (11in x 7in) with stations of each State in prominent type. Dial fitted with cou weight drive giving smooth tuning. Indicator lights are showing which band is in operation. Dial can be supplie cream, black or brown with matching knobs and escutche suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making ti simple and positive even on interstate, overseas and co stations.
All chassis are wired for the fitting of an F.M tuner or tap corder, special plug being provided on back of chassis, also pi terminals and outlet for gramo motor.
Power switch is fitted to volume control, radiogram switch bined with wave change switch. Audio end of set can be with T.V. receiver if required.

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Compare these new features of our HI-FI nine valve D.W. radiogram chassis with dual triconed speakers and separate bass and treble boost. Priced at . . . . . .
Frequency Response 40 to 13,000 Cycles — Max. Output 10 Watts.

£41/15/ F.O.R.

A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST.

The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

£44/15/ F.O.R.

Write for full specification

RECORD PLAYERS AND CHANGERS

We have a complete range of 3-speed record playing equipment, including Dual, Collaro or Garrard Players, with turn-over crystal pick-ups or your choice of Garrard, Stromberg-Carlson, Collaro or the new Dual 3-speed changer that will play 7, 10 or 12in records intermixed. All changers have turn-over Crystal pick-ups.

Classic Radio

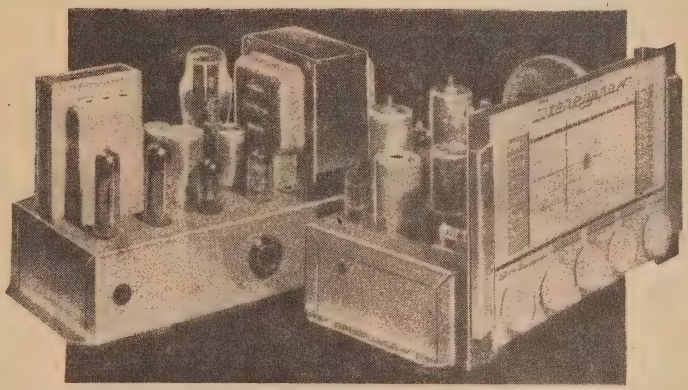
245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145

NEW Releases!

CLASSIC RADIO TAKE PRIDE IN ANNOUNCINC TWO NEW ADDITIONS TO THE ALREADY FAMOUS LINE OF HI-FIDELITY RADIOGRAM CHASSIS.

Stereophon LIVING SOUND

A compact 11-Valve High-grade Radiogram in two chassis, featuring a variable bandwidth Tuner, multi-input preamplifier and Tone Control in one unit, and a 10 Watt Ultra-linear Amplifier. Ideally suited for use with High-grade Pick-ups and Speakers.



SUMMARY OF PERFORMANCE

TUNER:

Broadcast Band. 2 position Bandwidth, whistle filter, EM80 Tuning Indicator attractive Dial

PRE-AMPLIFIER:

Microphone input sensitivity 1.5 mV
Pick-up input 1. High sensitivity 5mV
2. Low sensitivity 50mV.
Tape or T.V input sensitivity 100mV
All inputs controlled by one 6-position functional switch. Power switch on Volume Control.

TONE CONTROL:

Separate Bass and Treble Controls giving 20db boost to 18db cut for both controls. R.I.A.A. Equalisation for L.P and E.M.I. Equalization for 78 records

AMPLIFIER:

10 Watt Ultra-linear with Ferguson O.P. 301 Output transformer. 6BQ5 output valves
Frequency response. 30-20,000 cycles + or — 0.5db
Harmonic distortion better than 0.1 per cent.
Output impedance 15 ohms or as required

QUALITY never before at this PRICE **65 GNS.**

NEW SEVEN-VALVE HI-FI CHASSIS

SPECIFICATIONS AS NINE-VALVE CHASSIS—BUT WITH SINGLE OUTPUT VALVE AND 12in M.S.P. SPEAKER £29/15/- F.O.R.

ALSO AVAILABLE WITH MAGNAVOX 12W.R. HI-FI SPEAKER AND FERGUSON OUTPUT TRANSFORMER AT £4/-/- EXTRA.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145

"Q-PLUS"

NOW USED IN FAMOUS R.T. & H. TELEVISION SET

These "Q-Plus" Components were actually used in the television receiver described in the May, June and July issues.

'Q-PLUS' TV VIDEO OR SOUND INTERCARRIER I.F. STRIP

Remember, picture detail, amongst other things, is dependant on the video I.F. bandwidth—don't be misled, use only the original "Q-Plus" I.F. strip, as used by R.T. & H. Cheaper strips can be, and are, made; but the "Q-Plus" combination of over-coupled and bifilar transformers insures optimum bandwidth. Complete with all valves (4—6CB6's or 6BX6's, 1—6AU6 and 2—6AL5's) and full instructional sheets. The unit is wired, tested, aligned and sealed, full bandwidth 31.5-36.0 Mc/s, also available with the addition of a sound limiting stage.

TV

"Q-Plus" 5.5 Mc/s Sound Trap Type VIF7

A single tuned parallel resonate circuit with internal tuning capacitor in aluminium shielding can. Recommended as either a sound P.U., sound I.F. or sound trap.

"Q-PLUS" MKI T.V. VIDEO AND SOUND I.F. STRIP

"Q-PLUS" VIDEO PEAKING CHOKES TYPE VPC15 TO VPC560

Inductance values from 15 to 560 uH in preferred values (10% tolerance) pi wound on miniature high resistance iron cores with moulded in pigtail leads. "Q Plus" H.F. Filament choke type VPC-2. Inductance equals 2 uH. Current Capacity equals 5A. Layer wound on a high permeability iron core. Can be used as "spook" suppressor in TV line output systems.

VPC15-VPC560

VPC-2

"Q-PLUS" AT1-ALIGNMENT TOOL

Moulded from toughened nylon. Hexagon one end, screwdriver the other.

AT3 ALIGNMENT TOOL

Specially made for turret Tuners.

COMPONENTS ACCESSORIES

COMING SOON

"Q-Plus" will be releasing shortly a T-V cascode turret tuner. This tuner will have full bandwidth and cover all Australian channels.

WATCH FOR IT

?

MANUFACTURED AND GUARANTEED

R. W. STEANE & CO. PTY. LTD., AUBURN VIC

on this lug, also the 1000-ohm sistor.

of the .047 capacitors bridges to thed lug 6, the other to lug 5, here a lead runs to the linearity l through a choke to the damper

270pF bridges between lugs 5

4 provides the second anchor or the 1000-ohm resistor and for going B-plus boost lead. It must assed with a 16mfd electrolytic. lies along the chassis underneath output transformer.

or two other components require mention. The 1.5 microhenry in the original set was a small commonly found in disposals ent. It comprises about 30 turns nel wire on a former similar in a 1-watt resistor. It can be d conveniently between one lug on the linearity coil and a ug adjacent to it.

NTED ON SOCKET

two resistors to do with the F filament circuit are best d inside the shrouded socket, n blank base pins. The .22 ohm resistor was connected between and 7, while the 2200-ohm filter runs between pins 7 and 4. This herefore becomes the take-off or the EHT lead.

.22-ohm resistor had to be made the original instance from a of resistance wire wound over a tt resistor. It will probably be available, however, as a standard nent.

resistors should be kept close socket pins and therefore clear chassis, to minimise risk of discharge effects. Connecting ament wires calls for a certain t of care so that they will loop nderneath the socket, without ng the metal chassis and without undue strain on the insulation nsformer

dentally, the EHT cover should me closer than ¼in to the top the EHT rectifier.

LEAD

EHT lead can be a length of ade plastic high tension wire, ably not too stiff. For our own r we used a piece of small dia. coaxial type cable. The outer ng was stripped off while the ng was removed, then the outer ng was replaced, giving us a fine conductor, with a double layer of ade insulation.

king a proper EHT tube clip at ne, we bent up a scrap of spring to a "U" shape, the tips being slightly outwards to engage the n the side of the picture tube. To no trouble whatever has been enced with discharge or leakage in the EHT circuitry.

much then for the construction of ceiver. Next month we will have ning to say about getting it into ion and building the cabinet.

(To be continued.)

PARTS LIST

Section Two—Picture Circuits

1 EHT chassis and cover.
1 Hor. Sine Wave coil (CHS1)
1 Hor. Linearity coil (CHL1)
1 Hor Width coil (CHW1)
1 Centring Magnet assembly (MCA1)
1 Ion Trap Magnet asembly (MCA1)
1 Hor. Blocking Osc. transformer (THB1)
1 Hor. Output trans. (THO1)
1 Vert. Blocking osc. trans. (TVB1)
1 Vert. Output trans. (TVO1)
1 Deflection Yoke (Y70D1)
2 9-pin valve sockets.
1 9-pin socket, moulded mica-filled.
1 Octal valve socket.
2 Octal sockets, moulded mica-filled.
1 Skirted octal (for EHT rect.)
1 Socket to suit picture tube.
4 Video peaking chokes: 15uH, 47uH, 150uH, 330uH.
1 Miniature IF can and former, for sound trap.
7 Tagstrips: 4 SM28, 2 SM23, 1 SM27.
2 Resistor panels: 1 15-position, 1 9-position.

RESISTORS

2 2.5M tab-type pot.
1 1-meg. pot.
1 5000 ohm tab-type pot.
1 500-ohm pot
3 2.2M ½W.
1 .82M ½W
2 .47M ½W.
4 .33M ½W.
1 .22M ½W
1 .12M ½W
1 .1M ½W.
1 82K ½W.
1 68K 1W.
2 68K ½W.
2 47K ½W.
1 33K ½W.
1 27K 2W.
1 22K 1W.
2 22K ½W.
2 15K ½W.
1 12K 2W.
1 10K ½W.
1 3900 ohm 4W.
2 3900 ohm ½W.
1 3300 ohm ½W.
1 2200 ohm ½W.
1 1000 ohm ½W.
1 470 ohm ½W.
1 220 ohm 5W.
1 47 ohm ½W.
1 .22 ohm ½W.

CAPACITORS

1 200mfd. not less than 60VW.
1 25mfd. 40PV.
1 16mfd. 600PV.
1 8mfd. 350VW.
1 .5 or 47mfd. 600V.
1 .5 or 47mfd. 200V.
1 .25 or .27mfd. 200V.
1 .1mfd 400V.
1 .1mfd 200V.
3 .05 or .047mfd 600V. (or higher).
2 .05mfd 200V.
2 .02mfd 200V.
2 .01mfd 200V.
1 .01mfd. 10% mica or tub.
1 .0047mfd 200V.
1 .0022mfd. 10% mica or tub.
1 .0022mfd.
2 .001mfd.
3 270pF.
1 250pF.
1 110pF
2 82pF.
2 12pF.
1 20-220pF variable mica compression trimmer.

VALVES

1 12AU7
1 12BY7
1 12BH7
1 6SN7-GTA or 6SN7-GTB.
1 6BQ6-GTB/6CU6.
1 6AX4
1 1B3-GT.

SUNDRIES

3ft ⅛in dia. brass rod; 3ft 3/16in brass tube; 2½ft. ¾in. dia. brass rod; 2 couplers; 1 spring coupler; grommets; 2ft small dia. coax cable, power flex, hook-up wire, nylex tubing, nuts, bolts, washers, solder lugs.

RESEARCH MUST HAVE METHOD

(Continued from Page 19)

The brain, eyesight and the muscles can be subjected to rigorous treatment

During the days when the writer was engaged in bacteriological work he had to spend many hours during the day sitting at a microscope with the eye glued to the eye-piece. This puts strain on one eye. Then there was the sterilising room where one worked among steam and the great heat of autoclaves.

Other scientists are on their feet moving from instrument to instrument reading meters, analysing colors and detecting differences.

All these factors make it essential that the lab. itself as well as the work is well planned and under the control of an experienced Research Director.

It will thus be seen that scientific research calls for a high degree of skill and organisation. All experiment is based on the testing of hypotheses. If the hypothesis is incorrect the experiment will fail. It will also fail if it is inapplicable to the circumstances. This most often happens when some auxiliary hypothesis fails.

Apparatus may be unsatisfactory because of wrong or inadequate specifications. This may be because of error, lack of knowledge, neglect and lack of foresight.

Sometimes the construction of a piece of apparatus requires the greatest skill in workmanship and precision.

When you read of a new discovery it is hoped that all these things will be remembered and you will have a heart for the scientific experimenter.

Let's Buy An Argument

Television is so much in the air, these days, that it is difficult to avoid having argume about it. However, for the sake of those who might feel like saying, "What, not agai let me add that this article is not entirely given over to the subject. It only starts that w

by Neville Williams

THOUGH the subject of the post equalising pulses in a TV signal has not received honorable mention in these columns for a few weeks, it is certainly not dead. It stubbornly refuses to die.

Every now and again I am accosted with some jocular question about the aforesaid pulses, so that I'm beginning to resent them, much as a schoolboy must resent his red hair; or a vintage car fan, the necessity of running around for the rest of his life in an outdated vehicle.

Then again, there is a trickle of remarks and letters which purport to explain the whole problem in two short sentences — thereby ignoring the dilemna of numerous authors who, to date, have not been able to do so.

FURTHER THOUGHTS

I have been much more impressed by snippets of conversation with three particular readers who have given the matter more thought than most of us.

One is connected with a Common wealth research establishment and is interested in sawtooth oscillators for many reasons other than television. The other two are lecturers in television training centres and one of them is working on the subject as part of a thesis for his master's degree.

I have not had time or opportunity to establish whether they agree or disagree in their ideas but the consensus apparently is that the post-equalising pulses do have an effect on interlace, even though receiver designers may not appreciate the fact nor consider it in establishing component values.

It was even suggested by one of the said readers that the significance of the pulses was not fully appreciated when the standards were established. That they were included largely as a technical nicety to balance the pre-equalising pulses and against the possibility that circuits would be devised, which might conceivably trigger on the trailing rather than the leading stage of the f pulse.

In line with this, a reader from bane draws our attention to a sen on pp. 410-411 in Elements of vision Systems by George Anner.

PROVISION FOR FUTURE

After making the usual general ment about post-equalising pulses adds:

"Furthermore, at the time t standards were set up, it was lieved that future developm might lead to trailing edge sync so that these last six equalising pul were inserted to provide a degr of flexibility which might be quired."

To prove or disprove this state should be good clean fun for any who likes poring over records of proceedings. I haven't found any relevant personally, but that doesn't that it doesn't exist.

Concerning the effect of post-eq ing pulses, one of the ideas sugg is that, while the frame oscillator gers on the leading edge of the f pulse, it cannot thereafter be discou as "inoperative".

The suggestion is that frame os tors can act in varying degrees as lifiers during their conduction thereby transferring into their plate

SMALL ERROR

It is pointed out that only an tremely small timing error is nece in the 50-cycle frame oscillator to cel the half-line difference in the 15 cycle line oscillator and that very energy would need to be injected int timing circuit to cause trouble.

By having equalising pulses after frame block any residual carrier i mation, which may thus penetrate oscillator and affect the timing cir is kept uniform for successive fra But only just so!

The claim is that five equalising p in addition to the frame block are b sufficient to cover the conduction of practical oscillators. The Ru standards allegedly go to the other treme in this respect and provide fi equalising pulses fore and aft.

Whether all this is true or even remains to be demonstrated. It's o

ARE TV SIGNALS DISTORTED?

Dear Sir,

I wish to bring before your notice a subject to which I have given a great deal of thought and to which not one book I have read refers.

The subject with which I am concerned has to do with the vestigial sideband system used on video channels used on almost all modern television equipment. How do they get away with it?

To obtain the correct frequency response, the IF response in the receiver must be tapered towards and beyond the picture resultant frequency in familiar fashion.

Consider the effect of this: If the carrier is modulated by a low frequency sine wave, the modulation being 100%, the effect of the IF channel response is to reduce the sidebands and carrier to half their original level. Since the modulating frequency is low, the levels of the three frequencies is practically the same as at the transmitter and the result, on detection, is a sine wave.

Now consider a signal of sine wave form, about 3Mc 100% modulating the carrier. The lower sideband will not reach the detector and the carrier will be half its original voltage relative to the upper sideband.

Now at the transmitter the carrier voltage was twice that of either sideband so that, at the detector, two signals differing in frequency by 3Mc will be present at equal voltage. The output of a linear detector will not be a sine wave but will be a highly distorted 3Mc wave.

Now, in TV, while the modulation for a single frequency may not be 100%, it could still be sufficiently high to cause severe distortion.

The problem is this. Wouldn't this distortion affect the picture quality? If so why is its effect ignored? Furthermore, wouldn't the filters for obtaining the vestigial sideband effect, as well as the non-linear IF response in the receiver cause phase distortion to further compromise picture quality?

(N. R., South Perth).

use arguing interminably on the
n't-think-so-but-I-do basis.
hough video content does pene-
ie frame oscillator to effect the
e. then it should be capable of
emonstrated. The converse like-

be practical, the demonstration
have to go beyond this. It would
sufficient merely to show that
llator can act simultaneously as
olifier for a significant period of
would be necessary to prove—
rove—that significant extraneous
nformation can penetrate a typi-
h. separation stage in order even
h the said frame oscillator grid.

HAVE BEEN DONE

ourse, the work might already
een done, the only thing lacking
present discussion being a refer-
a particular article in a particu-
nal.
ther such an article or demonstra-
uld have much practical value is
matter. We have the post-synch.
but accurate interlace still re-
a problem.
can inspect dozens of typical
s without finding one which ap-
even visually, to be above re-
in this respect. Interlace is more
partial than complete; it varies
the screen and intermittently and
e setting of the Frame Hold con-

of the readers referred to above
e that he had checked 50 re-
of all makes and types during the
w weeks, on accurate equipment
one case was the interlace really
e.
t's more, overseas literature sug
hat the trouble is not confined to
air shores.
ss I am much mistaken, the prob-
oesn't reach the finesse of the
e effect of post-equalising pulses
much more to do with wander in
erating conditions of separator
cillator and leakage from the line
ne circuits.
le in the mood to discuss myster-
pseudo mysteries, have a look at
ter reproduced in the above panel
the heading, Are TV Signals Dis-

Y PROBLEM

ally, the letter came to hand some
go but was held over, because the
is a very "sticky" one and really
the scope of these columns. How-
in some degree, its practical im-
n receiver production was high-
by discussion at a recent meet-
the Institution of Radio Engineers
Division.
le not answering N.R.'s queries,
of the discussion was along paral-
es.
point was made there that ves
sideband filters do not behave in
shion that one might expect from
explanatory diagrams.
filters provide something like the
te roll-off, but certainly not com-
attenuation of the unwanted side-
Despite the best efforts of station
ers, the attenuation curve is
terised by prominent undulations,
quite significant sideband power
be radiated in the region where
is supposed to be none. Peak power levels of up to one kilowatt were suggested as possible in the "suppressed" region.

Phase distortion was mentioned as an attendant problem, and it was pointed out that the Standards require only that transmission characteristics should conform to the ideal as closely as the present state of the art will allow.

Similar problems occur in the receiver IF channel, where limitations of practice and cost produce curves which digress in varying degrees from the ideal and which are often characterised by severe phase distortion.

PHASE DISTORTION

This phase distortion could conceivably be responsible for a variation in picture quality between receivers which ostensibly had similar video amplifiers and comparable IF passband curves.

It was pointed out that many designers are satisfied to achieve an acceptable frequency response characteristic, letting phase angle vary as it will.

Others tend to favor some empirically derived response curve, which doesn't resemble the copybook pattern, but which, in their own receivers, is indicative of a suitable phase law.

A third group seem to favor the procedure of aligning for some initial curve, then "touching up" certain cores in the IF channel for the most favorable picture or test pattern. Their reasoning is simply that, phase or response notwithstanding, the picture is the thing that matters.

The queries raised by N.R. are therefore quite legitimate, in sense, though perhaps exaggerated in magnitude. One might ask, for example, how it would be possible to pass a distorted 3Mc signal through a video channel which must manifestly have a passband less than 5Mc?

But, as he points out, one won't find a detailed treatment of such subjects in a general text on television. Where mentioned at all, they are likely to be passed over with as little ado as possible.

But when, on the other hand, one finds a serious analysis of phase problems, it isn't light reading, not by a long shot!

And just before dismissing the subject of television for another month, I must confess to increasing irritation with a certain stereotyped phrase which runs . . . "the eye being more sensitive to faults than the ear . . ."

I might even have been guilty of using the phrase myself in past days but that doesn't make it right if, in fact, it's wrong.

The last time I heard this phrase was in a select company which only a few months before had been told about the extreme sensitivity of the ear to distortion—a sensitivity which has thus far eluded quantitative measurement.

You know the theme: "The eye is very critical of picture faults. To be acceptable, the picture must be the right height, the right width and be free from reflections and distortions. It must not suffer from interference effects, must not be too bright or too dull, must have an acceptable tone range, must show adequate detail . . ." and so on.

Of course, you can draw certain parallels in the case of sound reproduction but the list of requirements doesn't bulk quite as large as those for picture presentation. Sound must likewise be free from background noise and echoes, must not be too loud or too soft, must have adequate dynamic range, must exhibit wide frequency response and low distortion content and so on . . .

But if the list of requirements for picture presentation is longer than one for sound reproduction, that's about where the difference ends. If one can make insulting remarks about the sound quality which people accept, don't let's imagine that it's any different with picture quality. Overseas reports indicate that people grow to accept furry, dull pictures just as readily as they accept furry, dull sound.

On the other hand, when one considers sound or picture presentation from

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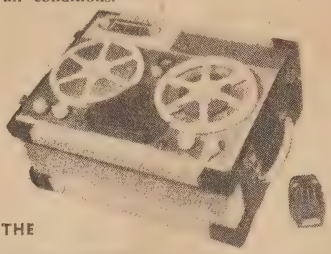

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"ECHO-ETTE" (Two Speed, 5¼inch reels) lightweight (19lb) in zip carrying bag

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★ Up to 5000 c/s at 1 7/8in/sec without flutter or wow (good quality for music)
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PYROX/AWA MAGITAPE 7½", as new £75
TRUVOX Two-speed. A magnificent recorder with Radiotuner, new £110

Magnegraph 7½" two track .. .. £
"FILMAG" 8 mm Unit (Demo) .. .. £
NOVA Type 00 in two cases, THREE head, new £192. Only £ Here is Your Chance. Don't Miss It!
New plastic tape, 38/6. Aurovox Plastic Tapes extra sensitive, or 51/9 each.

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FOR EVERY TYPE OF VALVE. "Nova" pioneered "Ultralinear" in Australia.
UP to 12 WATT (2 impedances). £4/17/6.
UP to 20 WATT (2 impedances). £6/3/-
Other types on application.
O/P Transformer for Playmaster 1 to 11 and for the

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Rewinds and any type transformer or coil to customer's specifications.
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NAME .....

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I enclose LARGE self-addressed envelope and 9d in stamps.

int of view of ultimate quality, omparison becomes somewhat us.

d reproduction has been de- l to the point where, within the of a monaural system, it is often t to find fault. We have reached ge of arguing whether instruments ally evaluate degrees of distortion the ear can perceive.

the same certainly can't be said picture presentation. When we at a certain television picture is , we are unconsciously judging nst what we know can or can't e with present standards.

RENT STANDARDS

e were to exhibit the same picture rint in a photographic exhibition, d be howled down for grain, poor lack of detail and other imperfec- lear to the photographers' art.

ou've ever seen television blown large screen size, think how it res with images from even a mod- mm slide projector. It doesn't pproach the limits of two-dimen- presentation.

draw comparison, then, between and aural acuity is plainly fatu- least until the eye has something while to work on.

aps the truth of the matter is uch comparison is fatuous, any- Then why perpetuate it?

for a change of subject.

n K.S., of Orange, NSW, comes r which may well express the sen- s of a good many other readers, ren't quite as close to things as of us who live, eat and sleep

n assure K.S., that, for such people. e of color codes isn't quite as bad makes it out. Without actually down to learn the code parrot- n, you do pick it up and begin ognise, resistors automatically by general appearance.

much the same process as ordin- ading. You don't have to work ery word as you go. You look conglomeration of letters like OMICROFARAD, and your mind well . . . "micromicrofarad".

THER EXAMPLE

do you see a figure in the dis- and begin to record, 5ft 2in, stout grey hair, large nose, aggressive r . . .

r mind simply says, "Heck, the r-in-law" and you duck the other

it is with resistors. You see a e of bands of red with some orange y and you think, "Ha, 22K". It's ly easier than having to pick the up, roll it over to reveal the num- f it's still there), then peer through bifocals to read it.

if color codes irk you, K.S.. of the many others whom they as-

t is, of course, provided the office asn't tipped some red paint in with llow to make it almost an orange. ldn't like to say how many times pored over an indeterminate color and wished my name was Picasso, d of what it is.

for the preferred value system, I nly be thankful that the article me good.

WHY DO THINGS THE HARD WAY?

Dear Sir,

As an old-timer I find it pretty hard to keep up with what is going on now in radio. The circuits are bad enough but some of the ideas round the place only make it harder.

Once you could buy resistors with the values printed on them and you only had to be able to read. Then they started using colors and a man had to be an artist as well as a reader, not to mention having to keep a color card around the place.

This was explained away by saying that figures used to rub off and I had to agree, a bit grudgingly.

Then came the business of these "preferred" values which I couldn't make head or tail of. I read your article and it just about convinced me, even though I felt a bit like somebody who's been convinced that he ought to swing for murder, even though he knows he didn't do it.

But the thing that I'm really crooked on is this business of rating resistors in watts. What's wrong with the old system of marking them straight-out in milliamps and saving everybody's temper? After all it's the current that heats them up and causes them to burn out if it gets too high.

K.S. (Orange, NSW).

Those old circuits?

Dear Sir,

As one who has followed your magazine since "Wireless Weekly" days, all articles are of more than interest to me, the "Argument" series especially so, and the "Serviceman's" trials strike many familiar experiences.

I have waited to see if someone would ask what I have hesitated to ask, as your time must be precious: What happened to the push-pull circuits for RF amplification and detection, as described and proved very good by "QST" magazine many years ago?

For short waves, the push-pull radio stage and ditto detection were the quietest working and smoothest controlled hook-ups I ever handled, despite low-slope tubes and other low efficiency gear. Nowadays, four-gang capacitors would compensate for halved capacity of series-tuned components, where once we switched in or out fixed capacitors paralleling the tuners.

Modern tubes should make it easier also.

The push-pull detectors used on the longer waves seemed to rid the set of many noises and did not make much complication.

I saw such detectors—less reaction windings — introduced after two straight radio stages and the set never overloaded at any time, giving fine quality results. If you cannot tell why the circuits are not used today, with your multiple experiences, I am at a loss to know where to enquire. (The circuits appeared in QST in 1930).

In my experiments, I used the reaction feedback via the centre of the grid coil instead of via each live end of the coil. Results were better and when using odd valves in the sockets—often a necessity as tubes were hard to get here — reaction could be individually adjusted to either one.

Trusting I have not wasted your time and hoping you can assist in this matter, I remain, Yours faithfully, A.F. (Charters Towers, Nth. Qld.)

Concerning maximum ratings, I well remember the resistors which K.S. refers to. They were wound on glass, cardboard or wood, were lacquered or dressed with paper labels and carried the value in ohms and the current rating in milliamps.

They were distinguished by one common feature. A 400-ohm 100mA resistor would always get much hotter than a 200-ohm 100mA resistor, even though both were exactly the same size.

Why?

Because such a rating, like the last statement in K.S's letter, is a half-truth.

It is a fact that the passage of current through a resistor produces heat and the more current that flows through it the hotter a resistor gets. But that's not the full story.

RESISTANCE ALSO

The quantity of heat which is produced is also dependent on the amount of resistance through which the current flows. It is, in fact, a direct ratio, so that twice as much heat would be developed in a 400-ohm resistance element carrying 100mA as in a 200-ohm element carrying the same current.

In the presence of such heat the actual temperature rise of the resistor is dependant on its ability to get rid of the heat by conduction and radiation.

The nature of the leads, the nature of the surface, the color, the mounting position and finally the size, all play a part in this.

If a certain temperature rise were accepted as permissible for the particular type of resistor, then more current could obviously be allowed to flow through the 200-ohm unit than the 400-ohm. In fact, the true rating would be found to be nearer 140-milliamps.

HOW OBTAINED?

How did I get this figure? Well, I might have obtained it practically, for all you know, using a variable current source and a suitable thermometer.

In actual fact, of course, I did nothing of the kind. I simply worked out what the current would be to produce the same heating effect in watts.

You object to this? Well, then, tell me: When you go to buy a radiator for the home, do you ask for one drawing so many amps or one rated at so many watts?

I wager that it will be the latter, because the number of watts tells you directly the amount of heat energy which the radiator will release into your room.

(Continued on Page 121)

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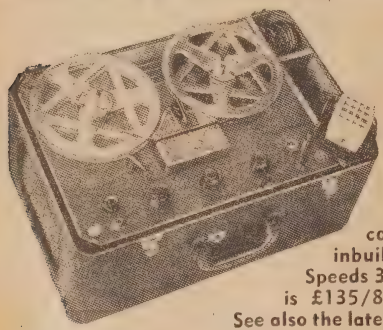

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OAD LINES FOR TRANSISTORS

h article, from the Aerovox Research Worker discusses the use of transistor characteris- ic curves for the determination of best operating conditions. Any radioman familiar with valve curves will find that transistor circuit design presents no serious difficulties.

HICAL constructions are of onsiderable aid in designing elec- be circuits. Load lines drawn the plate current-v.-plate voltage of curves yield circuit constants portant operating data. This ly simple procedure eliminates edious calculations.

hical constructions are equally n the design of transistor ampli- cuits. Similar advantages are d.

ansistor work, load lines are con- on the collector Vc/Ic family of to determine operating point, load ce, distortion, collector current nd base current values. The tech- s similar in every respect to that ed in tube work.

article will show, by illustrative es, how to use the load-line tech- n transistor amplifier design.

re 1 shows the circuit of a typical n-emitter. RC-coupled transistor r stage.

common emitter, also sometimes the grounded-emitter, is widely cause it affords high power gain, ltage gain, 180-degree phase re- similar to a tube and good fre- response.

n the constants of this circuit, lly the load resistance (RL), col- supply voltage (Vcc) and collector- ter voltage (Vce) are chosen in way that the internal parameters transistor determine largely the

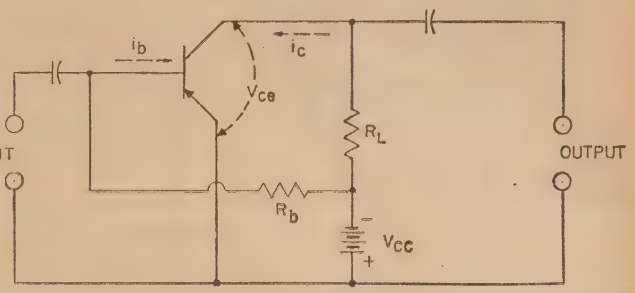

Figure 1 —Common-emitter Amplifier with series base resistor.

For common-emitter operation, the family contains a separate curve for each of several typical base-current values and is a plot of collector-to-emitter voltage Vce, versus collector current, Ic.

If such a set of curves is not available in the transistor manufacturer's literature, the operator must plot a set by making a series of common-emitter DC measurements on the particular type of transistor which is to be used in the amplifier.

The procedure is to set the base bias current at a given level (zero base current is one such level) and to vary the collector current (supplied by a constant current supply) while observing the corresponding voltage between collector and emitter.

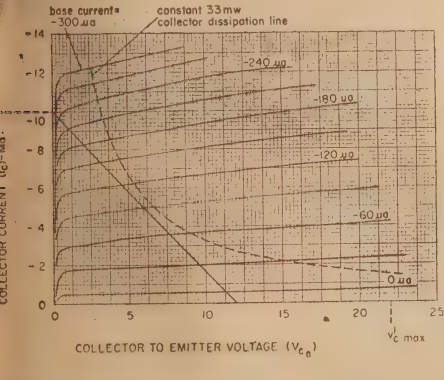

Figure 2 —Common emitter collector family with load line construction (Raytheon CK71 transistor).

In the graphical construction, follow this procedure:

(1) Label the points of maximum collector current and maximum collector voltage on the graph. Figure 2 is a family of curves for the Raytheon CK721 transistor. The maximum collector current, from the manufacturer's data sheet, therefore, is —10mA, as labelled in Figure 2, and the maximum collector voltage is —22 volts.

(2) Draw across the curves a plot showing the current and voltage intersects for the maximum dissipation (Pc) in watts recommended by the manufacturer. In the case of the CK721, Pc equals 33 milliwatts and is represented by the dashed line which bends across the collector family in Figure 2.

At any point of intersection of this line with abscissae and ordinates, the product VcIc equals 0.033.

In determining the points for the dissi pation curve voltages may be selected along the horizontal axis and corresponding current values calculated (Ic equals Pc/Vc), or current points may be selected along the vertical axis and corresponding voltages values calculated (Vc equals Pc/Ic).

The area of the graph below and to the left of this curve encloses all points which are within the dissipation rating of the transistor. All points in the area above and to the right of this curve represent overload and must be avoided.

(3) Select the operating point of the transistor (that is, collector voltage and collector current) and the supply voltage.

(4) Mark the operating point on the graph. Example: see the dot at the intersection of the 6-volt and 5-milliampere lines in Figure 2.

(5) Construct a load line from the supply voltage point on the horizontal axis, through the operating point, to the vertical axis. This is the solid line in Figure 2.

(6) Determine the required load impedance, RL, by computing the slope of the load line. (RL equals DVc/DIc.)

Several facts are evident from an examination of Figure 2, a typical example of transistor load-line application.

(a) The operating point has been selected at Vcc equals 6V, Ic equals 5mA.

(b) With a supply voltage of -12 V, the load line extends from -12V to -10mA. The load resistance accordingly is DVc/DIc equals (0-12) / (0-0.01) equals 1200 ohms.

(c) The entire load line is seen to be within the dissipation rating of the CK721, being 3 milliwatts lower than the constant dissipation curve at the point of closest proximity.

(d) The base current level which will bias the transistor for the 5mA. collector current at the operating point is seen to be 90 microamperes.

ng point of the amplifier, ineffici- eration, high distortion, or poor y usually result.

proper choice of the operating vith respect to the transistor char- ics and supply voltage, low-dis- class-A performance easily is ob- safely within the transistor maxi- atings.

graphical construction, the first ment is to obtain a set of collec- curves, such as those in Figure 2. transistor chosen.

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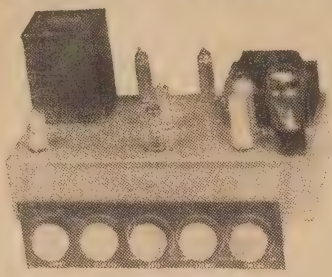

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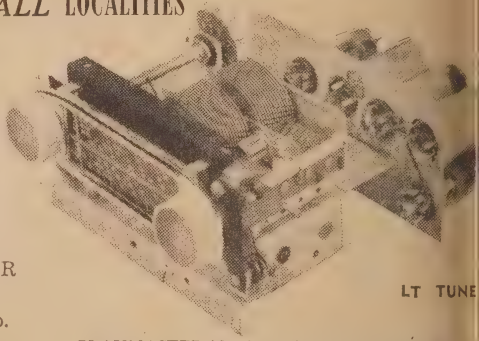

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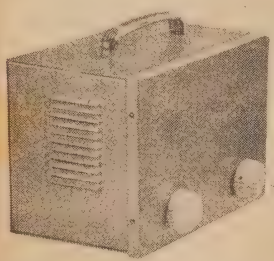

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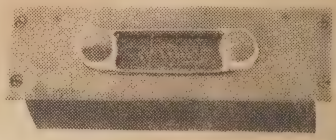

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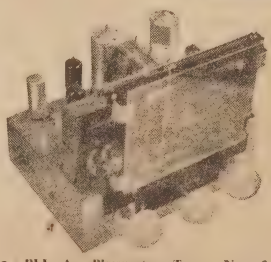

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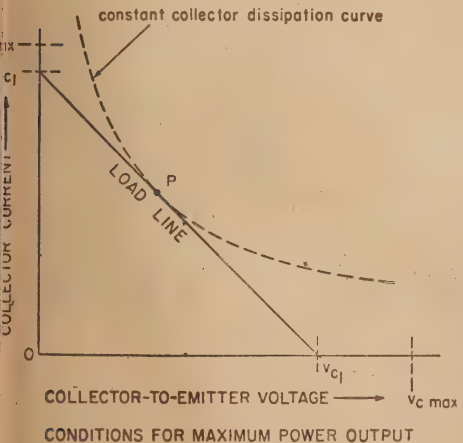
he preceding example the supply
e was assumed fixed. The operat-
int was chosen and the required
resistance determined from the
of the load line. It is easily seen
different procedures might stem
other combinations of known and
wn factors.
example, the operating point and
esistance might be given and the
d supply voltage left to be deter-
or the load resistance and supply
might be specified and the oper-
point placed at any satisfactory
n along the resulting load lines.
desirable that the collector signal-
swing encompass as much of the
or characteristics as is feasible.
will ensure maximum output
e.
s, with the operating point set at
nA in Figure 2, the collector signal
e may swing down the load line
0 microamp base-current curve
p the load line to the 210 micro-
ase-current curve without encoun-
the severe bending at the left ends
se curves.
vever, it is obvious that the upper
traverses a larger number of base-
t curves than the lower swing,
e of the progressively closer spac-
f the curves at the higher base-
t levels.
assymetry of signal waveform due
s condition may be minimised by
g the swing to the region of more
equal base-current curve spacing,
low distortion is a more important
ive than maximum output.
collector current at the operating
is a function of the base bias
t, Ib. Reference to Figure 2 shows
b must be 90 microamperes when
quals 1250 ohms and Vcc equals
lts. This base bias current may



CONDITIONS FOR MAXIMUM POWER OUTPUT

Figure 4 — Conditions for maximum power output.

btained from a separate battery or
Vcc through a series dropping re-
, Rb in Figure 1.
se bias also may be obtained from
tage divider (Rs/Rb), operated from
and an emitter series resistor, Re,
Figure 3.
e required value of series resistor,
in Figure 1, may be determined
the simple relationship Rb equals
Ib. where Rb is in ohms, Vcc in
and Ib in amperes. For the 90-
ampere base current indicated in
e 2, Rb equals 12 divided by 9
times 10 to the power minus 5, equals 133,500 ohms.

In this calculation the internal base-to-emitter resistance Rbe of the transistor is ignored, since its magnitude is very small with respect to Rb.

There is some objection to using series-resistor base bias in the common-emitter circuit in the way shown in Figure 1, because the high external resistance, Rb, in the base circuit tends to free the transistor for rather wide shifts of the operating point resulting from the effects of temperature on the internal parameters of the transistor.

The base biasing scheme illustrated in Figure 3 overcomes this difficulty, stabilising the operating point against temperature changes as well as against variations between individual transistors.

In this arrangement the supply voltage, Vcc, is reduced by the divider network, RsRb, and this lower potential is presented to the base of the transistor. Resistor Re in series with the emittter then limits the base current to the desired bias value.

Re is bypassed heavily to minimise the effects of degeneration. Current through the RsRb leg is chosen high enough that resistances Rs and Rb may be made small with respect to the internal resistances of the transistor.

This circuit satisfies the condition for stability that any external resistance in the base lead must be small and any external resistance in the emitter lead be made as high as possible.

For maximum power output a condition extremely important in the operation of conventional transistors since their power output capabilities normally are low compared to tubes, the load line should enclose as large an area as possible within the maximum current, voltage and power dissipation ratings of the transistor.

Figure 4 illustrates the condition for maximum power output, although not necessarily at low distortion. The known supply voltage value, Vc1, is located along the horizontal axis.

A load line then is drawn from Vc1 to the vertical axis so as to be tangent to the constant collector dissipation curve at a single point, P. The load line intersects the current axis at Ic1.

Both Ic1 and Vc1 are seen to lie within the maximum ratings (Icmax and Vcmax). The slope of this line (Vc1/Ic1) yields the load resistance.

Graphical constructions are particularly serviceable in large-signal systems design, of which the class-B power amplifier is a typical example.

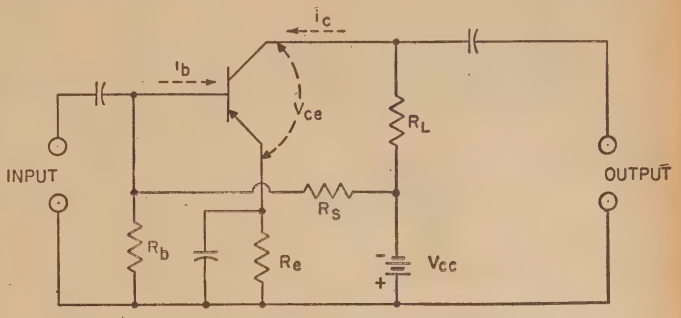


Figure 3 —Common-emitter Amplifier with base-bias stabilization network.

REFERENCES

For additional information concerning the application of the load-line technique to the design of transistorised circuits the reader is referred to the following publications:

Fundamentals of Transistors, Leonard M. Krugman (New York, John F. Rider Publisher Inc., 1954), pp 26, 63, 77-81, 92, 93.

Principles of Transistor Circuits, Richard F. Shea et al (New York, John Wiley and Sons Inc., 1953), pp 125, 143, 144, 148-155, 160-163, 430-432.

Transistors, Theory and Practice, Rufus P. Turner (New York, Gernsback Publications Inc., 1953), pp 36, 57, 58, 83-86.

The use of load lines in the determination of driving and output conditions, load resistance and operating characteristics of transistorised class-B amplifiers has been covered in the article, Class-B Transistor Amplifier Data, which appeared in the January, 1955, issue of the Research Worker.

A satellite on TV

WHEN the first man-made earth satellite starts its flight from US this year it may be watched on TV in Britain.

Plans are being discussed for siting of a TV camera on the 13,653ft high Jungfrau Mountain, in the Swiss Alps, and linking in with the European TV network.

Scientists are being consulted by the BBC to decide whether the man-made moon will swing in an orbit likely to bring it within range of a camera on the Jungfrau—or on any other mountain where it could be seen on the screens.

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)W LONG SHOULD AN AERIAL BE?

question of how long an aerial should be is very similar to the old riddle "How long is a ice of string?" It all depends on what you want the string for—or the aerial for that matter. Maybe this article will give you some guidance.

tate what might be the obvious, aerial is intended to pick up ignals.

is not so obvious is why a parkind of receiver seems to go best long aerial or a short aerial or cular kind of aerial.

a crystal set for example. They on't work at all, unless used with substantial aerial and generally h as well.

e's nothing really surprising about A crystal set has no means of ing the incoming signal, so that y energy available to operate the ones is the energy which can be ated by the aerial system.

bigger and better the aerial sysne more energy it can intercept e louder will be the signals.

E THAN LENGTH

there's more to making a big and e aerial than using up a length . For example, one could get 100 insulated aerial wire and string g the fence. It would certainly an aerial, but not a very good one. aerial would have a lot of capacito earth and would load heavily cuit to which it was coupled. But, h a limited height, it would not n much voltage or current from nal energy available.

w aerial loses out in two ways—because height above ground is the factors which governs signal and secondly because the signal ear the ground is often reduced y by other metal objects, like fence iron roofs guttering, clothesline on.

putting up an aerial to get the ignal, the prime object must therefe to get as much of the aerial as s possible and well away from ic objects which might reduce the available to it.

what is the limit to the length of n aerial? Fifty feet? A hundred Two hundred feet? A mile?

CTICAL LENGTHS

l, anybody who has the time and ce to put up a mile-long aerial rite and tell us about it. As for ther dimensions, it's a matter of is practical or necessary.

hin a few miles of the transmitting ns, one should get all the signal ary for a crystal set using say, et of aerial, erected about 25 feet We assume, of course, that it would ected properly, with insulators at nds and the lead-in kept clear of ing, etc., on its way down.

15 or 20 miles from the transmitmight be well worthwhile to use hing a bit bigger if at all possible y "bigger" we mean extra height ll as extra length.

Merely to make an aerial longer, hout increasing height, may not ke as much difference as one ht expect.

In any case, a good earth is essential for best results.

Why?

Well, simply because the signal currents induced in an ordinary aerial tend normally to flow through the receiver's aerial coil to earth. If the earth circuit is poor, the signal currents will be reduced, much as a resistance will reduce the flow of current through any other electrical circuit.

The fact that a crystal set will sometimes work without an earth wire doesn't disprove this. Signal currents still flow to earth via the capacitance which exists between the wiring, the phone cord, the listener's body and so on and earth.

Does this mean that a crystal set will always work better with a large aerial and earth connected to it than a smaller aerial?

Well not always, or not straight away. A large aerial may "load" the tuned circuit too much and so reduce its selectivity and upset its tuning that overall results may suffer. But that's not the end of the story. By tapping the aerial further down the tuning coil, the position can be restored.

COIL TAPPINGS

In fact, if a new optimum tapping point is found, results will generally be better than ever. In other words, a large aerial tapped well down a coil is generally better than a smaller one tapped further up.

If the tappings can be manipulated, you can prove this point. On the other hand, if the set has only a single fixed connection for the aerial, it may just have to be used with the length of aerial which suits this tapping best.

Course in Television

Part 22 of our "Course In Television" had to be omitted from this issue. It will appear, as usual, next month.

But what about one-valve sets or other little regenerative receivers?

Well, because they have the ability to amplify incoming signals, such receivers can operate with less input signal and therefore smaller aerials than a crystal set.

This is a valuable feature, because it gives one the opportunity of using a small aerial, if that is important. In fact, in a strong signal area, it might be possible to use a small aerial and no earth, which is very convenient.

However, that wouldn't mean that the set would be giving peak performance. It might bring in more distant stations by using it with a good aerial and an earth as well.

But — the "good" aerial would not necessarily be connected to the same point as the small tone. The loading effect of a large aerial on a tapping or a primary winding meant for a small one may be enough to upset its performance completely and prevent the set from operating near the verge of oscillation.

To get the best out of a small set with a large aerial, the best position of the aerial tapping, or the number of turns on the aerial primary winding (if one is used) should be established by trial and error.

The point behind all this is that, the bigger and more efficient an aerial is, the better will be the performance of the set — provided the aerial coupling is adjusted for optimum.

The idea of using a bigger and better aerial works out fairly well for small receivers but it isn't always successful for domestic receivers of the 4 and 5-valve variety.

These sets can provide a very high degree of amplification and do not require very much signal to produce ample volume from the loudspeaker. In fact, too large an aerial and too much signal can be an embarrassment.

It works out this way: The primary winding is usually adjusted on the assumption that the set will be used with a very modest aerial, no more than say 20 feet. This is realistic, because that's the way the sets are normally used.

LOADING AND SELECTIVITY

If coupled to a larger aerial, loading effects may reduce markedly the selectivity of the aerial coil. This can allow signals to pass directly into the converter grid and IF amplifier, where they can heterodyne with the wanted signals or other "accidental" signal components which are present in a superhet.

Alternatively, the very strong signals may produce overload and cross-modulation effects.

As a result, the receiver may exhibit "cross-talk" and whistles as it is tuned across the band, particularly around 930Kc, which is double the nominal intermediate frequency.

In such a case, the obvious cure is not to use too long an aerial. The alternative procedure of modifying the aerial coupling is out of the question with a commercial receiver—even if one could guarantee that it would be completely worthwhile.

This puts the DX fan in a spot if he wants to use a long aerial and try for distant broadcast stations. The rather grim fact is that neither his location nor his receiver may be suitable for such activities. It is asking a lot of any modest receiver to operate at full gain with a large aerial attached in the immediate vicinity of strong broadcast stations.

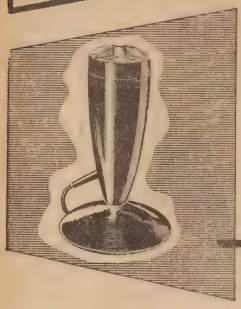
Further away from the stations, where the risk of signal penetration, overload and cross-modulation are less urgent, the same receiver may give quite a good account of itself with a large aerial.

On short waves, the problem may not

acos

A COMPLETE RANGE FOR EVERY PURPOSE

CRYSTAL MICROPHONES
MICROPHONE INSERTS



DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6.**

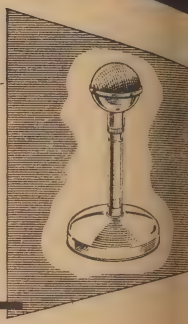
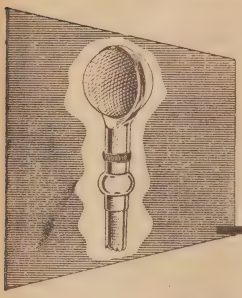


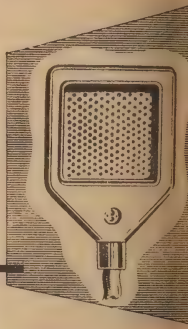
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE, £9/18/6.**



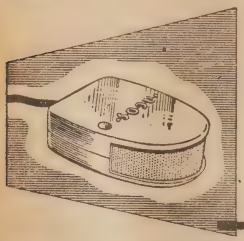
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6.**

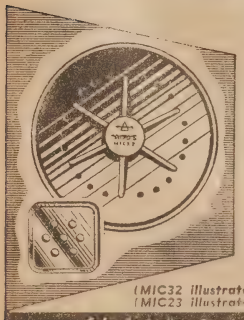


GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**

HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



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These inserts are available in varying sizes, ranging from as small as ⅛ in. square to 1-⅛ in. round, with various thicknesses from 3/32 in. to 5/16 in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

(MIC32 illustrated)
(MIC23 illustrated)

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because few listeners have the tune of living in a nest of power- ortwave transmitters. As a rule, ossible and worthwhile to use an ve aerial say about 50 feet long s high as practicable.

the reasons stated earlier, the aerial may be too long for the the broadcast band and some- may have to be done about it. nately, there is a simple stunt which ive the nuisance of having to use erials so suit the set.

S CAPACITOR

loading effect and input from a erial can be reduced by wiring a capacitor in series with the lead- re. Something like .0001mfd is but higher or lower values can ed if need be. A simple switch e used to short out the capacitor ort waves.

question is often asked about special resonant type aerials, as n amateur stations. Such aerials no special virtue unless you want as the amateurs do—confine listen- one or two narrow bands. For l shortwave listening, such aerials t likely to be an advantage.

ious "fancy" aerial designs have publicised for combatting noise. can only be an advantage if the of the noise is very close to the r—tram wires, power lines in the electrical apparatus in the same house.

oise-reducing aerial with a special can then be an advantage, be- it allows the aerial proper to be d away from the source of noise nto the open, where the signal p from the station is likely to be

ere the noise is of a more general , blanketing a district, a noise- ng aerial may not make much dif- e, unless the aerial proper can be d very high. And, of course, special s are of no advantage against atmo- c static.

VISION AERIALS

evision aerials are in a class apart, se television services operate in HF band.

such frequencies it becomes neces- in more remote areas, to pick up ch signal from the station as pos- It is often necessary also to signal energy which may be re- d from buildings or prominences e side of the direct transmitting These signals are likely to cause d" images on the screen.

h needs are best met by using s which have a natural resonance e incoming signal frequency, and possible at the very high frequen- sed because the equivalent wave- is short.

order to preserve the characteris- f the aerial, it must also be used a special connecting cable running to the receiver and this is the n for the twin transmission line is usually specified.

ious complication arises from the that television aerials are usually ed to operate on signals from ns on a variety of frequencies and alls for a great deal of compromise anipulation to obtain the so-called d-band" characteristics.

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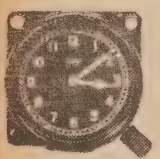

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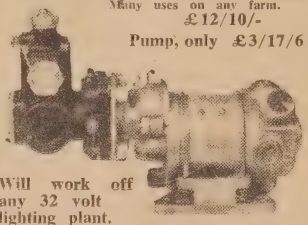

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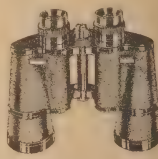

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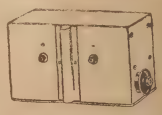

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Here's your answer, Tom!

Several readers have submitted this month's queries which range from the design of a communications receiver, to the usual problems of small sets and the components that go to make them up. The first six are based on a reader's efforts to design a communications set.

Is it true that solid copper wire works better than Litz wire, at frequencies above 3 Mc in the tuned circuits of a communications receiver?

The main advantage of Litz wire is low resistance to radio frequency currents, due to reduced skin effect. It thus possible to wind coils with a higher Q-factor than those wound with solid wire of a similar cross-sectional area. This is a distinct advantage in coils involving a large number of turns.

However, at frequencies somewhere above 3 Mc the value of inductance required in a tuned circuit is quite low, and it becomes possible to wind coils of quite small dimensions using heavy wire solid copper wire. At very high frequencies the coil is often small enough to become self-supporting. Under these conditions the advantage of litz wire largely disappears and solid copper gauge wire is generally preferred.

★ ★ ★

At what frequency would iron-dust slugs, of the type normally obtainable over the counter, cease to increase the efficiency of a coil? Would an iron-dust cored former of about ⅜in diameter be more efficient than an air-cored former of perhaps ⅜in diameter? How would the frequencies for which the coils are designed affect the matter?

It would be difficult to give a precise answer to the first part of your question, Tom, because one could not guarantee the characteristics of a core obtainable over the counter". A few years ago, cores were a proposition only at a few megacycles whereas, today they are used as a matter of course in the 6 Mc IF channels.

At the very least, it would be essential to establish that the cores you buy are suitable for use at the frequencies you have in mind.

Ideally, the use of a core should permit a given inductance to be achieved with fewer turns of wire, thereby minimising RF resistance and increasing the efficiency of the coil. In practice, however, losses in the core are likely to increase with frequency until a situation is reached where efficiency is much the same with or without.

The advantage remains, however, that the inductance can be varied conveniently by screwing the core in or out of the former and this is probably the prime reason for their use in current receivers.

We'd only be guessing, Tom, about the relative merits of the larger or smaller coils mentioned with unspecified cores and frequencies. However, our guess would be in favor of the larger ones, provided you aren't worried about the facility for varying the inductance.

★ ★ ★

Would a local oscillator, operating at a higher frequency than the signal, track better if some of the plates in the oscillator section of the gang were removed? Would there be any advantage in doing this in a receiver covering from the broadcast band to 30 Mc?

No, Tom, there would be no practical advantage in removing plates from the capacitor and, in fact, far from being an advantage, it would only lead to difficulties at the higher frequencies.

On the broadcast band, the signal frequencies are only a little above the intermediate frequency of 455 Kc. The aerial tuning capacitor has to tune over a much higher frequency ratio than the oscillator capacitor and it would be possible to reduce the number of plates—as is sometimes done.

However, on the short-wave bands, the frequency range covered by the oscillator tuned circuit approaches closely that covered by the aerial tuned circuit and therefore the gang sections need to have much about the same maximum capacitance.

This being the case, it would not be practical to remove many—or any—plates from the oscillator section of the tuning capacitor.

★ ★ ★

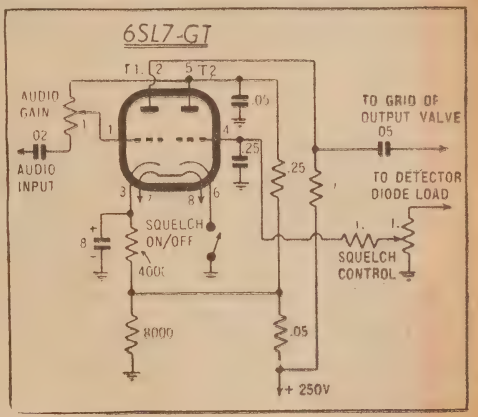
What is a "squelch" circuit and where is it used?

A squelch or muting circuit is reproduced in an accompanying diagram.

☆

A simple squelch circuit which has proved very successful in practice and requires only one twin-triode of the high-mu type.

☆



Such as the 6SL7, is most convenient for the purpose.

The action of the circuit is as follows: The audio output from the detector is applied to the grid of the first valve. The output of this stage is available at the plate, and is normally fed through an RC network to the grid of the output valve.

The operation of the stage is governed by the second triode which operates as a DC amplifier, and is directly coupled to the first valve.

When a signal reaches the diode of the detector valve, it develops a negative voltage across the diode load which is applied to the grid of the second triode. This triode reaches plate current cut-off quite easily, due to its high-mu characteristic and low effective plate voltage. Without plate current, there is no voltage drop across the plate load and consequently the first triode operates with normal bias.

In the absence of a signal, however, there is little or no voltage across the diode load and consequently no bias is applied to the second triode. This causes the second triode to draw appreciable plate current, producing a voltage drop across the plate load.

This, in turn, causes the grid of the first triode to become substantially more negative than the cathode, which is returned to a positive point of a divider

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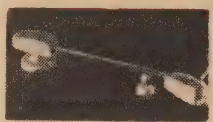
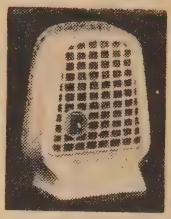


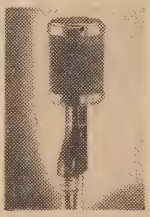
FF2-OV, FF2-P. "Fonofluid" turnover crystal pickup with alternate response characteristics



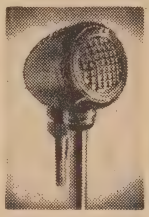
44. Hand or desk mounting, counter balanced base, ivory plastic housing

CS3. Hand or stand, omnidirectional, black plastic housing and hand grip.

HM7. Hand or stand microphone, filtercell, robust diecast housing attractively finished



S742. Duo cell, omnidirectional, suitable for cable suspension.

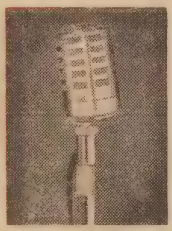


B110. Plastic torpedo form.

R474. Studio type, 4 cell, omnidirectional.

R572 and R572/L. Studio type, duo cell, omnidirectional, high or low impedance

[illegible] and RFCS/L. Single cell semi-directional, high or low impedance.



URA/S and URH/S. Ribbon velocity with sliding type muting switch. High or low impedance.

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s in the plate circuit of the pre- stage.
n this occurs, the first triode cuts no audio signal is able to reach tput valve, thus silencing the re-

is possible to alter the amount on the second triode and, there- he signal intensity necessary to the receiver operative. This is ed by varying the setting of the t control.

type of circuit is widely used ile and monitor receivers, but it lso be applied to domestic re- to silence background noise be- stations.

★ ★ ★

think that the 6AK5 valve is tter RF amplifier than a type the EF50. However, is the 0 more reliable?

rather difficult to make an un- d statement that one valve is than another, since circumstances nfluence the matter considerably. erms of ultimate characteristics, K5 is probably better than the the difference being most notice- the region above 100 Mc. How- this is probably far higher than g you have in mind and, at frequencies, there may not be a deal to choose between them.

have always found the EF50 to y reliable and, in view of this and apness, it may be the best propo- for a home-built communications ir.

★ ★ ★

sing a 6AK5 for a mixer tube grid or cathode injection, how- ld a receiver's performance, icularly the signal-to-noise o, be affected by the use of a de local oscillator or a pentode ?

signal-to-noise ratio is not norm- ffected much by the local oscil- To a great extent it is a func- of the mixer tube noise, particu- if the mixer is the first tube in ceiver.

choosing the oscillator valve and , the most important characteris- undoubtedly stability both in t to mechanical stress, heating, and to variations in operating e.

er that come matters of circuit nience, ease of coupling to the and availability of components.

★ ★ ★

Which would be better as a local illator—a 6SK7 or a 6AC7? there any special precautions take to ensure that the injection tage is constant in a receiver ing a frequency ratio of 2 to 1?

feel that a low Gm type valve as the 6SK7 is preferable as an tor valve mainly on account of rger electrode spacing. In a valve s type variations in the electrode g due to heating effects and anical vibration are less likely to drift.

r experience with short-wave sets been that, all things being equal, is no need to take any special precautions to ensure that the injection voltage is constant. Once a suitable average amount of coupling has been selected, performance is not likely to be affected much by varying that coupling for particular bands.

★ ★ ★

I have a one-valve set using a twin triode which has a two-volt filament. The set is not working properly as I am using 1.5 volts on the filament. Could you tell me how I could obtain 2 volts using dry batteries?

We are not aware of any currently available twin-triode valves with a 1.4 volt filament and, other than the use of a 2-volt accumulator, your only alternative is to connect a dropping resistance in series with a 3-volt battery.

The calculations involved are quite simple and require a knowledge of Ohm's Law.

First, it is necessary to know the current drawn by the filament of the valve you have. The information may be found in valve data handbooks but, taking a typical example, we have the type 19 and the type 1J6. Both types have identical operating characteristics with the exception of the filament current. The type 19 draws .26 amp while the 1J6 draws .24 amp.

In the case of the 19 valve, since we wish to drop 1 volt at .26 amp, it is only necessary to divide 1 by .26 which equals 3.9 ohms approximately. A 4-ohm resistor should do nicely and it would also be close enough for the 1J6-G.

Resistors of very small value are usually difficult to obtain through normal channels, and it may be necessary for you to wind one. Resistance wire or ordinary enamel covered copper wire is suitable and details regarding the length required for a given resistance may be obtained from the wire tables which are a feature of a number of handbooks. The gauge of wire need not be heavy since the resistor will not be required to dissipate more than ½ watt.

★ ★ ★

Is it possible to convert an AC set to battery operation? If so, how?

It is possible but not economical to operate an AC set from an accumulator through a vibrator type inverter unit. From dry batteries it would be quite impractical.

Mains operated sets consume comparatively high power which would result in a very short battery life. The power consumption is directly connected with the current requirements of the heater and high tension circuits. The current drain of the valve heaters and dial lamps of the average 5-valve set is likely to be about 2 amps. Even if this was halved by series parallel connection, no dry battery, normally available, could be expected to deliver this current for any length of time. Much the same would apply to the high tension requirements which could be from 50 to 80mA for 5-valve sets. The life of "B" batteries would be very short if used under these conditions

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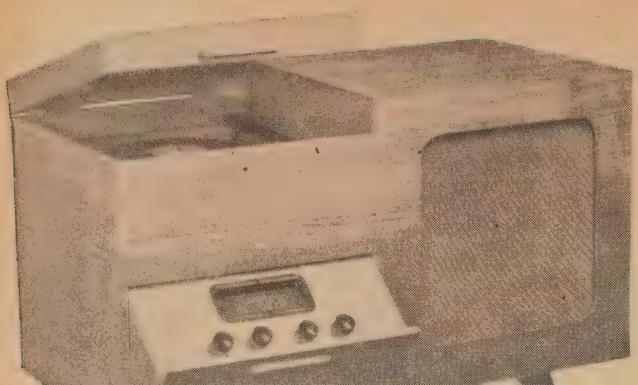


We used a 12-inch speaker in the cabinet, but smaller diameter units will do. An acoustic filter, described on page 99, cuts down box resonnace.

At left is a picture of the finished inet, the details of which are given the opposite page. The cabinet can used with all standard record pla end changers, or with other circuitry long as the original chassis dimens are not exceeded

How To Build Your Radiogram Cabinet

In last month's issue we described a general purpose radiogram using modern valves and de signed for the standard type of record player or record changer. This article concludes th project by fully detailing the cabinet we built to go with it, and the method adopted t "baffle" the loud speaker.

THE cabinet, as the illustrations will show, is a horizontal, contemporary design much in favor at the present time, and capable of being put together by a home carpenter of even modest ability.

The diagrams included here have been prepared with this fact in mind, and only the very simplest construction is employed.

NOTE FOR EXPERTS

If you have acquired some facility in cabinet work, you will not need anything further to work from, for the chances are that you will have your own ideas about the best kind of joints to use, and how the completed cabinet will be finished.

But no one need be ashamed of the way in which our modest effort turned out, and it has been much admired by visitors to our workshop.

Of greater interest to the constructor are likely to be the steps we took to treat the cabinet acoustically.

It was pretty obvious what would happen to the sound when a 12-inch speaker, or any other type for that matter, was operated in the speaker compartment left in its original state.

As a general purpose baffle it didn't do too badly, but there was a pronounced boxiness, particularly on speech, the result of cabinet resonance around about 120 cycles.

Running an oscillator through the amplifier confirmed the presence of a pronounced peak in this region.

Now there isn't a great deal one can do about making a purse from a sow's ear, or in making a first class baffle from a box about 18 inches square. It might be possible in this space to work out an RJ enclosure or some other clever scheme, but in our experience this would call for more than average know-how concerning the ways of enclosures, and the final result might well be worse the first. Constructionally, too, the quite a bit of work involved.

What we felt was a better line to was a treatment of the enclosure t its obvious resonances as much as sible, and to accept the degre baffling which remained.

The obvious way to do this is to up the capacity of the cabinet by the insertion of acoustic filters or b which, even if they still allow minor resonances to occur, would s them out over a broad band, and vent them from building up notic increased output at one particular

VERSION OF "BOFFLE"

One method of doing this desc by Hartley under the title of the H "boffle" has apparently met with siderable success.

Into a box of about the same si ours, he introduced a series of felt partitions, each with a central of a different diameter, so that section operated as an acoustic The final partition was a solid secti felt, and the whole was intended fo with a speaker having virtually no ance.

Examining the idea to find out h worked, it became apparent that a deal of trial and error had gone it, but that its main virtue coin with our own aim, to break up th capacity and cut resonance to the mum.

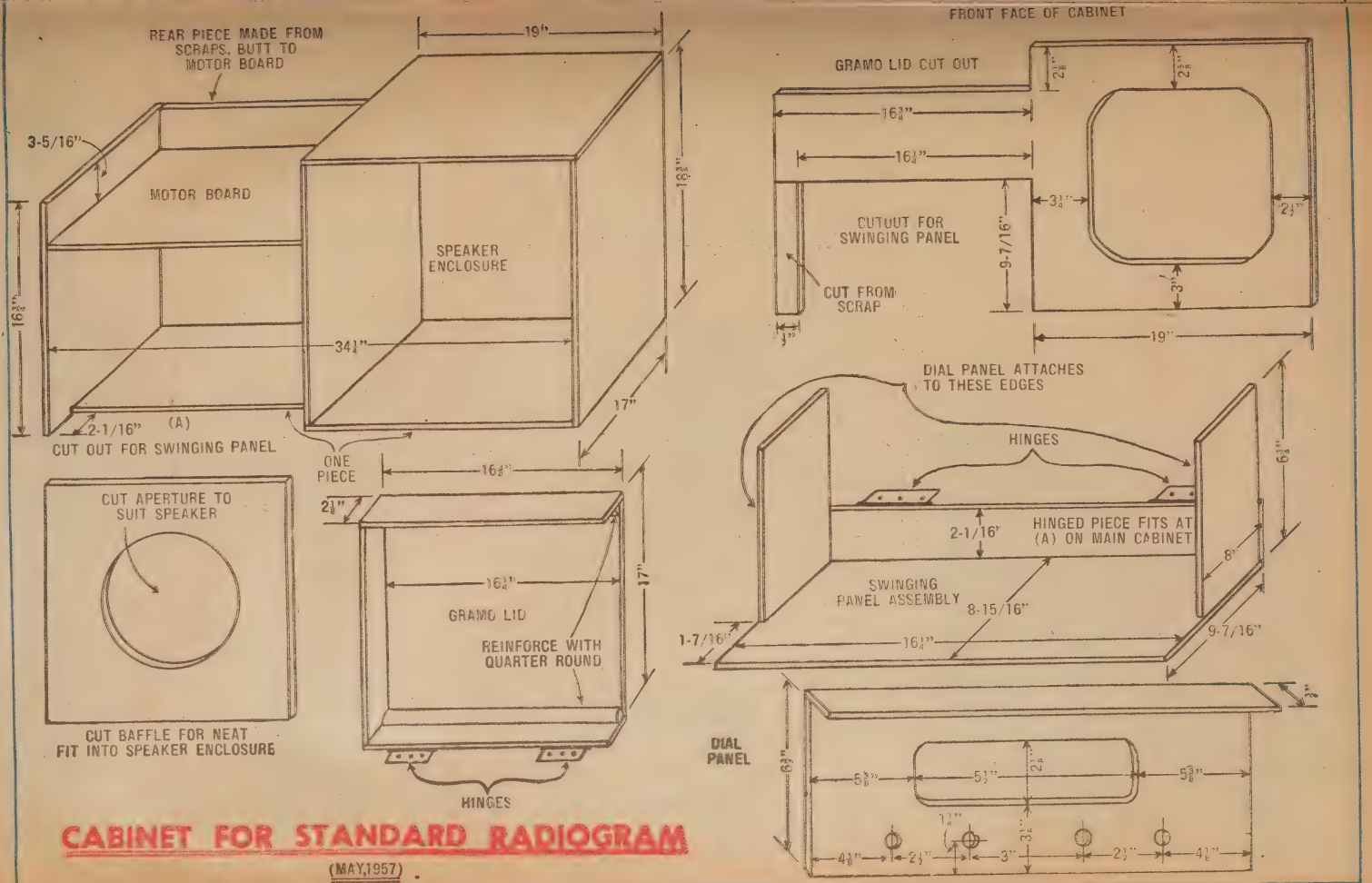
We decided to follow the same eral treatment, but because the ar of felt material easily available wa pensive and not very easy to h we used a sheet of Caneite, a b sound-absorbent material of mo cost and widely-used for acoustic ment.

The idea of cutting holes of va diameters at the centres of the rec lar sheets seemed to be a good on no successive filter section would have a similar dimension, and we therefore expect a reasonably s attenuation of the back wave.

NOT AIRTIGHT

The Caneite is a much more material than felt, and it was the not considered a good idea to mak last section completely airtight. among other things, would have the speaker resonance by an appre amount, and built-up air pre would have caused considerable tion of panels.

At low frequencies there is con able radiation from the hole in the



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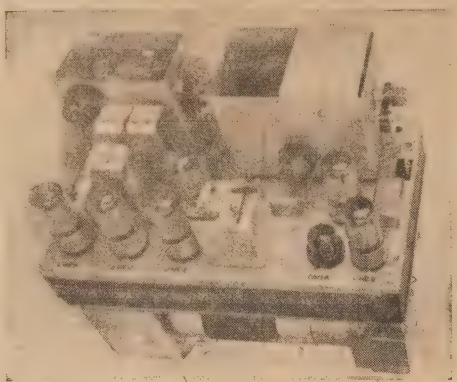

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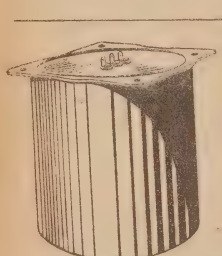

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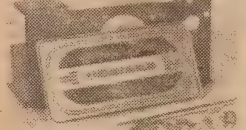

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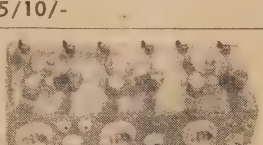

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Gauges		Enamelled	Prices Per Yd	
B&S	SWG		SCE	SASE
15	18	5d	6d	6d
16	20	4d	5d	5d
22	23	3d	3d	3d
24	25	2d	2d	2d
26	27	2d	2d	2d
27	29	2d	2d	2d
28	30	1d	1d	1d
29	31	1d	1d	1d
30	33	1d	1d	1d

17. Bakelite Former can be supplied cut to the length you require.

Diameter	Price per inch
1in	5d
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1½in	6d
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3in	10d

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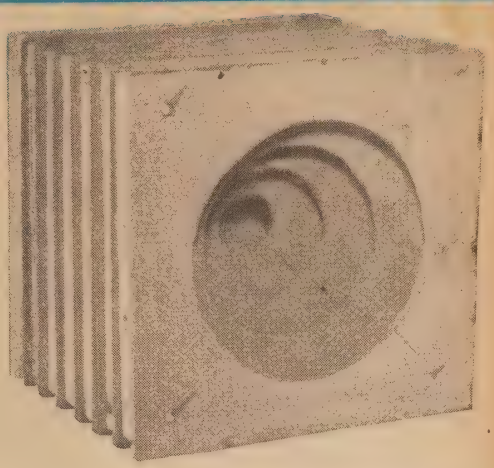
DETAILS OF SPEAKER BAFFLE



Here is the complete baffle unit, made up of a series of Caneite panels each with a different sized centre hole. These are spaced apart by wooden frames, and the whole assembly is held together by four rods at each corner. Its purpose is to remove cabinet resonance.

ovided the cabinet is not housed
p against the wall of the room,
not likely to be a bad thing.
dimensions we used are all de-
n the diagrams, and follow fairly
the pattern set by Hartley, al-
our "boffle" obviously does not
in exactly the same way as the
l.

oes, however, prove remarkably
ve in removing the objectionable
resonance.

llator tests showed that although
was still a slight rise around the
ycles mark, this was reduced to
n extent as to be virtually negli-
or all practical purposes, and lis-
tests on radio programs showed
ur efforts were amply justified.

R BASS

he same time, the general quality
s response was greatly improved.
s do not compare with those of a
nclosure, but it is possible to hear
erable output as low as 30 cycles
a 120X loudspeaker adjusted for
room volume.

re is nothing about the suggested
sions which are intended to apply
cally to any make of speaker, as
re purely empirical, and the diffi-
of applying any useful calculating
ds are such that we doubt whe-
ny substantial variations from them
be worth while.

you are a student of such matters
ight be able to try out some other
which would work equally well.
n fact, the whole subject lends it-
some interesting experiment at low
Our only word of warning would
use materials which have no hard
ting surfaces, and to see that, what-
your constructional methods, the
unit can be clamped solidly to-
to avoid rattles and undue vibra-

e success of this method of treat-
has considerably revised our atti-
to the use of speakers in small cab-
Results are far beyond anything
ve tried in the past with such mod-
quipment and, given a good pro-
from radio or records, they are
impressive.

NSTRUCTIONAL DETAILS

w for some constructional details:
prototype cabinet was built from ½
maple plywood, using approxim-
one and half 6 x 3 sheets. To
purchasing two whole sheets, it
be possible to purchase off cuts.

ensure a minimum of waste, com-
e by marking out the various sec-
to be cut from the whole sheet.
uld be possible to cut these so as
eep the grain continuous on all
. Double check as you go because
rror is irreparable once the sheet
t.

single 6 x 3 sheet will yield the
face, the two sides, the bottom
and the two top sections. A num-
of off-cuts will also be available for
of the sub-assemblies.

lowance must be made for saw-cuts
planing or sanding, as the dimensions
are for the finished unit.

e method of construction that we
ted is essentially simple but, as we
ted out earlier, we felt that the
od had to be such that it could be quite easily duplicated by the average hobbyist with limited woodworking knowledge and facilities.

The joints to be made are simple but, joints, glued and strengthened with panel pins. Screws may be used, but only if one is prepared to experiment with the shade of an appropriate filler, which even then may betray its presence by breaking up the grain structure.

FASTENING METHODS

We found that panel pins were quite adequate and, that due to the number of panels reinforcing one another, the whole structure was quite solid. Screws were used in out of view places mainly to play safe and allow for a greater margin of rigidity.

To assemble the pieces already cut, use the method outlined, commencing with the speaker enclosure. The top partition attaches to and overlaps the edges of the two sides. The right side attaches to and overlaps the bottom piece, while the left side does not overlap but directly attaches to the top and bottom pieces.

Continue the construction, adding the extreme left side, the motor board and the rear end piece which supports the gramo lid. This piece attaches to and overlaps the motorboard and, the whole assembly is then attached between the inner face of the left side of the cabinet and the outside face of the left side of the speaker enclosure.

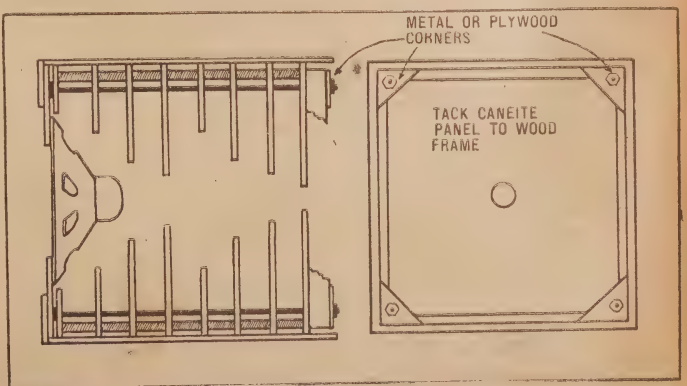
A further step is to add the front partition and the whole assembly may be weighted down and left to dry. In the meantime carry on with the cutting and construction of the sub-assemblies.

The swinging panel assembly consists of the front panel, the dial panel, the two sides and a rear or bottom piece depending on the angle of viewing.

Butt the two sides and the rear piece to the front panel, the rear piece overlapping the sides. Next, prepare the paned carrying the dial escutcheon and attach it to the front edges of the side pieces. A few panel pins driven through the front panel will help to make the assembly rigid.

A pair of hinges attach to the rear piece, and the whole assembly fits into an appropriate cutout on the main cabinet, the respective portions being labelled (A) on the diagram.

The gramo lid may be tackled next, two sections of which have been cut out



This diagram of the "boffle" unit shows how the panels fit into place.

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1in	1-8in	2 9
1in	3/32in	1 9
7/8in	3/32in	1 9
¾in	3/32in	1 6
¼in	3-64in	1 3
9-16in	1/8in	1 6
7/16in	1/16in	1 0
5/16in	1/16in	0 8
¼in	1/32in	0 6
5/32in	1/32in	0 5

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12SK7	10/6	6A3	17/6	801	25/
12SG7	10/6	6D6	12/6	807	22/6
12A6	7/11	6G6G	12/6	830B	40
12K8Y	12/6	6F8G	12/6	811A	70/
12SC7	12/6	6L7	12/6	955	25
12SJ7	12/6	6SL7GT	12/6	954	5/6
12SL7GT	10/6	6V6G	12/6	955	10/6
12SR7	12/6	6Y6G	12/6	958A	10/6
2V3G	15/-	6SA7GT/G		6V6	7/-
803	60/-		12/6	6V66	15/-
25L6GT/G	15/-	6SF5	7/6	EF50	3/6
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DC volts—10, 50, 250, 500, 5000v (20,000 Ohms/volt).
DC current—5 micro amps; 2.5M/A; 25 M/A; 250 M/A.
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0 db—0.775 v—600 ohms.

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Resistance—0-100K.
Size—3¼" x 2½" x 1¼".

Packing and registered postage for these, 6/-.

dlier operations. The remaining
s consist of the rear and side
ed and, may be cut from off cuts.

ch the top piece to overlap the
nd side pieces, while the front sec-
n is attached to overlap the front
e of this assembly. Lengths of quar-
nd mould may be used to rein-
ce the front and rear pieces. The in-
rfaces and edges of the lid may
ed with light felt to silence needle
d and prevent acoustic feedback.

et of Swedish legs will complete
binet and leave it ready for the
g and polishing operations. We
to purchase the legs ready made
hey are comparatively cheap, and
e spent in making them could well
oted to the remainder of the cabi-
Legs 12 to 14in long should be
ite.

ch the legs to the underside of the
t to centre approximately 4½in
ach side and facing diagonally to
orner. It would be wise to use
screws and glue in attaching the
ince obviously these will have to
y secure.

ACE FINISH

surface finish of the cabinet may
several forms, and we are leaving
tails to the individual. Staining of
ber followed by an application of
lacquer will undoubtedly be a
ur and simple method. French
ing, although more complex will
ave its adherents.

w a few words regarding the
r baffling: A baffle is cut to fit
into the speaker enclosure with an
re to suit the type of speaker to be
The speaker may be attached to
oard by means of countersunk
or wood screws.

or to inserting the baffle into the
ure, cut a piece of expanded
mm, or other suitable speaker
material, and attach this either to
ont panel or the baffle board. The
may now be secured to the front
using wood screws.

re are seven filter panels of caneite
milar sound absorbing material.
panels are cut to fit neatly into
closure, and spaced one from the
by wooden frames. The frames
e made from either rough or dress-
ber finishing 1½in x ¾in.

e caneite panels have circular cut-
concentrically placed and graded,
argest cutout being closest to the
er. The diameters of the circles
12in speaker are as follows: The
circle to just clear the speaker
, the second to have a diameter of
he third and fifth a diameter of 7in.
ourth and the sixth a diameter of
hile the seventh has a diameter of

PANELS

e panels with their wooden spacers
be pre-assembled into a pack, held
ner by four brass rods threaded on
end, and the whole assembly tight-
with bolts and suitable sheet-metal
ers.

order to ensure that the holes
gh the four corners of the caneite
are uniform the following method
prove helpful: Insert the partitions
the enclosure, then place a length
d with a suitably ground tip in the
of a drill, and pierce the assembly
gh each corner.

e partitions are then withdrawn, and

NEW BOOKS

THREE interesting booklets have been sent to us from Data Publications of 57 Maida Vale Rd. London W9, publishers of the Radio Constructor.

TV FAULT-FINDING, DATA BOOK SERIES NO. 5, of 90 pages, is profusely illustrated with photographs taken from a TV screen, and is a well written and informative analysis of many difficulties, common and obscure, which the TV serviceman meets.

Many of them are illustrated by distortions of the standard test pattern C which is used in Australia, and their clear reproduction makes them most valuable.

The accompanying text naturally deals with the British system, but because the fundamentals involved are clearly explained, their application to our own standards is fairly clear in most cases.

THE RADIO AMATEUR OPERATOR'S HANDBOOK, DATA BOOK NO. 6, contains 48 pages of handy reference to amateur Prefixes (grouped by Block allocation, by Countries, and Alphabetically), Zone Boundaries, Call Areas, Time conversion Amateur Abbreviations, etc., which is well worth having.

Again much of this is applicable particularly to Great Britain, but much of it is universal.

RADIO CONTROL FOR MODEL SHIPS, BOATS AND AIRCRAFT, DATA BOOK NO. 9, has 140 pages, and is a most comprehensive manual.

It is written by F. C. Judd, G2BCX, a developmental engineer for Radar Navigational Aids.

It is written simply, and with considerable attention to detail, so that an experimenter with only an elementary knowledge of radio can find his way.

The radio equipment described is essentially simple, and there are many clear circuit and working diagrams to guide the constructor.

Naturally the bulk of the book deals with the electrical side, for this is most likely to give worry, and must operate efficiently not only for good results but to avoid interference with other services.

The mechanical side is covered by a chapter on servo-mechanisms and general control methods again with profuse illustrations.

Reference data on aerials, valves and batteries and the mounting of apparatus in the finished model, are also included.

Models controlled by radio provide a fascinating field for experimenters intent on combining their radio and mechanical knowledge. They will find a book such as this invaluable.

---

either reassembled as a pack or inserted individually on to the rods in the enclosure. The assembly is made rattle free by tightening the nuts.

If a smaller speaker is used the diameters of the holes may have to be decreased. Although we cannot give exact dimensions, the hole diameters would have to decrease roughly in the same proportion as those for the 12in speaker.

The CATHODE RAY OSCILLOSCOPE, by J. Czech. Hard cover, 338 pages generously illustrated by photographs and drawings. Philips Technical Library series.

From an expensive instrument found only in well-equipped laboratories and understood by few, the cathode ray oscilloscope has, of late, become an essential item of test equipment for domestic television receivers, high fiedlity equipment and industrial electronics gear.

This new book, written with the above as background, will be appreciated by oscilloscope users ranging from almost the beginner to the advanced worker.

It is divided into four parts, each carefully subdivided into sections in such a way as to increase its value as a reference. The tendency is for each section to start right at fundamentals and gradually develop the more involved ideas.

Parf I deals with the general theory of the instrument the individual sections dealing in turn with the CR tube, power supply, amplifiers and time base. Due space is devoted to multivibrator and Miller-transitron arrangements as are mostly found in current instruments.

Parts II and III discuss measuring techniques, theoretical work being supported by practical examples. In addition to the more routine applications connected with radio and television receivers, we were pleased to find some more specialised ones. For example, space is devoted to oscillographic methods of testing camera shutters, the action of flash globes and associated circuits.

Data on oscilloscopes, both simple and advanced, which could reasonably be duplicated by workers with moderate facilities plus some experience with electronic gear.

An excellent list of refarences plus a detailed index complete a book which we are glad to recommend to Radio, Television and Hobbies readers.

Our copy direct from N. V. Philips' Gloeilampenfabrieken, Eindhoven, Holland. The local distributors are Philips Electrical Industries Pty. Ltd., 69-73 Clarence St., Sydney, and the price is £3/10/- (M.V.F.).

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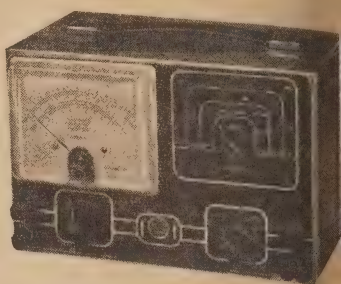
TV
TEST INSTRUMENTS

by UNIVERSITY GRAHAM

Multimeter (20,000 ohms per volt) Model TVR/MM

This new Multimeter, built to the standards that University Instruments have laid down for many years, is designed as a quick checking portable instrument for TV and radio servicemen to carry with them. A.C. voltages, D.C. voltages and output voltages may be checked in ranges of 3, 10, 30, 100, 300 and 1,000 and there are six ranges of D.C. current from 100 micro-amperes up to 10 amperes, 5 ohms ranges allowing resistances from one half ohm up to 20 megohms to be checked are obtainable with self-contained batteries, and the large W4 all polystyrene meter is employed. Light in weight and readily portable, this rugged multimeter will be handy for all types of service.

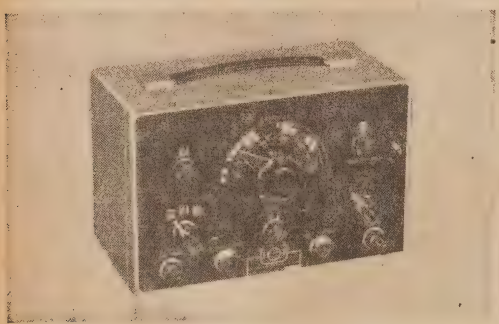


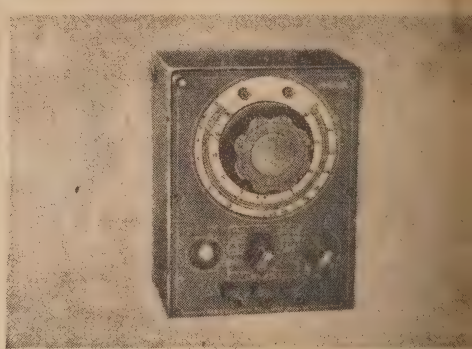
Resistance Capacity Tester, Model UBA

With the complex circuits in TV receivers employing many capacitors and many resistors, this special instrument provides a good standard of accuracy together with ease of handling. It covers an extensive range of resistance measurements from .1 ohm to 10 megohms and capacity measurements from 10 micro-micro-farads to 10 microfarads. It is accurate and sensitive and is overload proof. A calibration system is incorporated to enable rapid checking of the apparatus of any instrument, and internal standards are adjusted to an accuracy of plus or minus 1 pc

Pattern Generator, Model TVR-PG (Below)

This instrument is one of the basic instruments required for testing and adjusting TV receivers, and produces RF or IF carrier waves, amplitude modulated by video signals to produce horizontal bars, vertical bars or cross dot pattern, comprising both horizontal bars and vertical rows of dots. The carrier frequency is from 30 to 40 and 50 to 110 megacycles in fundamentals and 100 to 220 megacycles in second harmonics. Horizontal bars from 8 to 10 are available and vertical bars from 8 to 12. On cross dot pattern the number of horizontal bars can be varied from 7 to 20 and the number of vertical rows of dots from 8 to 12 by means of controls provided. Many new features make this attractive for TV service organisations





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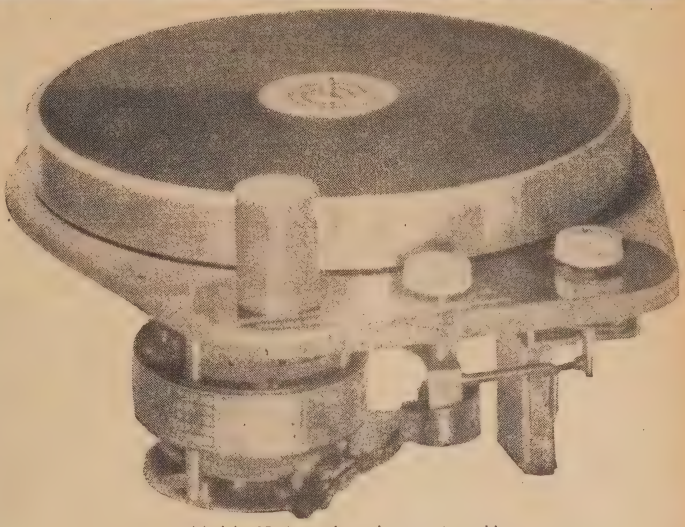
TRADE REVIEWS AND RELEASES

HIGH-GRADE GRAMOPHONE MOTOR FROM COMMONWEALTH ELECTRONICS

The Commonwealth Electronics Model 12B four-speed gramophone motor recently sent to us for test proves to be a powerful, smooth running unit, sturdily built and well designed as one would expect from a quality product in the upper price bracket.

The motor is slung by means of flexible mounts from a cast base-plate which also supports the turntable. The shaft of the motor carries a four-step pulley, and a simple mechanism with a large jockey wheel so that it engages the pulley to select the correct speed for the required speed. The jockey wheel drives the inner edge of the turntable and is removed from contact when the motor is switched off. A simple brake plate slows the table to a stop at the same time. Mounted in the base plate is firmly mounted the motor board, the motor vibration of which is very small, is entirely cushioned up by the flexible mounts. The turntable is a heavy, cast non-magnetic alloy which runs freely in bearings pressed into a cast socket housing integral with the base plate.



Model 12B 4-speed synchronous turntable.

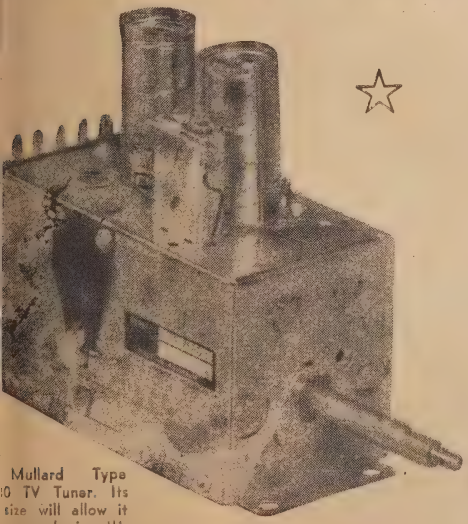
Speed is selected by a rotating knob, and includes the 16 2/3 speed. A lamp is provided under a cylindrical shroud for use with a stroboscope and to help accurate placement of the pick-up stylus. The makers intend to fit a switch so that it can be extinguished when not required.

On a test run of several days the motor ran smoothly and with very little vibration. By touch it was virtually impossible to detect whether the power was switched on or not. Its rumble figures must be below that of most gramophone discs.

Model 12B with a large synchronous motor lists at £36/17/6 including tax, and there is a second model 12B/1 available with a smaller, induction type motor for £28/10/6.

TEN CHANNEL TV TUNER AVAILABLE FROM MULLARD

Home television set builders will be interested to know that a ten-channel turret tuner is available now from Mullard Australia Pty. Ltd., Clarence St., Sydney. It is one of a number of TV components available from the Company.



Mullard Type 10 TV Tuner. Its size will allow it to be used in the A & H TV chassis.

THE tuner is conveniently compact, the main chassis section measuring approximately 5 x 3 x 2¾in. Height of the valves and output transformer is additional, while the concentric control shaft protrudes by about 2¾in.

A turret action is used for channel selection, the makers claiming for this, advantages of reliability and electrical efficiency. It is pointed out, further, that adjustment or repair can be carried out on any one set of coils without affecting other channels. Silver-plated contacts are used throughout.

The 10 channels covered are those planned for the Australian television system, when it is ultimately in full operation. This involves a frequency coverage from 49 to 216 Mc.

The input circuit is designed to match a 300-ohm balanced transmission line, as used with current type aerials.

Output frequency is 30.5 Mc from the sound carrier and 36 Mc from the picture carrier. The tuner includes bandpass and filter circuits which, according to published data, give an IF rejection ratio of greater than 3000 on the high bands and greater than 500 on the low bands. Quoted noise factor is respectively 8.5 and 6db.

Designated as type AT7580, the tuner uses a 6CW7 twin triode as a cascode RF amplifier. A 6BL8 triode-pentode serves as the mixer oscillator. The oscillator is temperature compensated against frequency drift by the use of a selected negative temperature coefficient ceramic capacitor.

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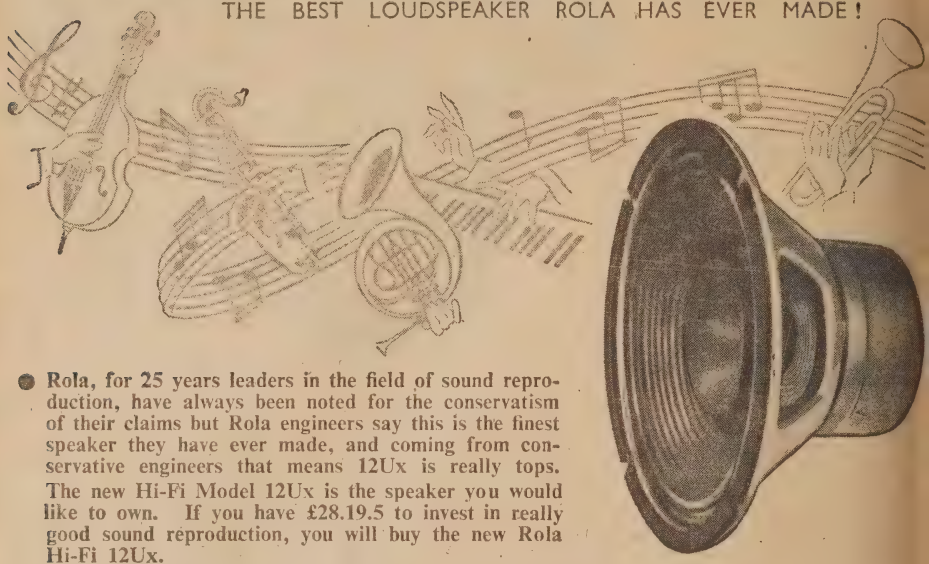

● **Rola, for 25 years leaders in the field of sound reproduction, have always been noted for the conservatism of their claims but Rola engineers say this is the finest speaker they have ever made, and coming from conservative engineers that means 12Ux is really tops.**

The new Hi-Fi Model 12Ux is the speaker you would like to own. If you have £28.19.5 to invest in really good sound reproduction, you will buy the new Rola Hi-Fi 12Ux.

Its brilliant transient response will bring to your living room every delicate nuance of the original sound—the booming of the tympanis, the realism of clashing cymbals, the tinkling of the triangle.

● **If you are interested in technicalities, here are the details:**

Frequency response	**40-14,000 c.p.s. flat ± 6 dB**
(Usable response to 30 c.p.s. in the Rola recommended vented enclosure).	
Power handling capacity	**20 watts**
Intermodulation distortion : (F1/F2 ; 45/7,000 c.p.s. ; Ratio 1 : 1)	**Less than 2% at 20 watts output**
Voice coil impedance	**15 ohms at 400 c.p.s.**

● *But it is your Ear that is the Final Judge*

Hear the Hi-Fi 12Ux and you will agree with us that Rola has produced Australia's finest loudspeaker—a speaker which will more than hold its own in world competition.

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OFF THE RECORD — NEWS & REVIEWS

eethoven must now be well ahead in the list of recorded works by any composer. This nonth is no exception, as still more versions appear, nor is there any sign that the flow will ecrease. No one should have any difficulty in making a choice to suit his taste, at least of the major works.

by John Moyle

BEETHOVEN—Symphony No. 1 C major, Opus 21—Symphony . 8 in F major, Opus 23. Played the Orchestre de la Suisse Ro-nde, conducted by Ernest Anser-et. Decca LXTA 5232.

doubt whether I have ever heard rmet in Beethoven prior to the re- of this record, and the result is what one would expect.

is extremely neat—that is probably best single adjective to use about it. ry careful work has gone into its aration, as you will be aware if you for his control of tempo, for in-e.

he first movement of No. 1 is as a place as any to observe how tively this is done.

do not mean that you will hear any gerations, or ear-catching stunts.

t the temptation is often to treat e symphonies as fairly simple stuff, to let them play themselves.

nd, indeed, they are in gentler mood most of those that came between after them.

As to the recording, I was struck with its clarity and definition. You would have little difficulty in following it with the score if you were so inclined, and noting how exactly everything is in its place. I'd be surprised, too, if you found Ansermet very far out in his speeds—I checked a few against the accepted standards, and they were very close. Not that I suggest you develop a metronome complex!

It may not be a particularly brilliant performance, but it is a very satisfying one, and the orchestra's typical dash and deftness are all there.

BEETHOVEN—Quartet No. 7 in F Major, Opus 59, No. 1 (1st Rasoumovsky), played by the Hungarian String Quartet. Columbia 330CX 1203.

You will need to like your Beethoven played at high speed to appreciate the record, for I don't think I have ever heard it rattled off at such a pace.

Decca released a version by the Italian Quartet not very long ago, which almost stands still by comparison.

Each interpretation is colored by this matter-of-fact speed. The Hungarians are deft enough, but with their tempo goes a sense of hurry which I found rather disturbing. There was even a tendency to clip notes and phrases here and there, which may not be authorised in the score.

The Italians, on the other hand, are more meticulous if less enterprising, and although they do lag at times, I think they get more from the music than their high-speed contemporaries.

This is most noticeable in the first movement, where the music almost sounds a different thing between one and the other.

In recording, the Italian has a clear edge. The new record is cut at a much lower level, and the players are much less forward.

While I have not heard chamber music records which can equal some of the earlier Westminsters in this regard, the Decca comes nearest to it.

You can easily pick differences in timbre of instruments which, with the Hungarians, it is often hard to separate.

These Rasoumovsky Quartets contain some of Beethoven's finest work, and should not be treated so summarily.

Personally, I'd like to see something issued between these two performances. Failing that, I'd have to let the better recording of the Italians choose their version for me.

DELIBES — Ballet Music from Coppelia and Sylvia. Played by the Orchestra of the Paris Opera, conducted by Michel le Conte. Capitol P-18001.

The impact of this recording isn't as great as Decca's, reviewed last month, which was a particularly forward disc.

Capitol's version hasn't nearly the same force, and the extra distance to the microphone is, I think, greater than it need have been.

The orchestra doesn't do quite as well as Decca's although this is a comparison rather than a criticism.

If you prefer a lower-keyed performance you will like it. But the extra Decca brilliance will attract many.

The arrangement of selections is not quite the same, and, of course, there is a more complete Coppelia by the Coven Garden Orchestra.

I should think that lovers of Delibe are now well catered for.

HALLE EXCELS IN A NEW SYMPHONY

VAUGHAN WILLIAMS—Sym-hony No. 8 in D minor. Played by he Halle Orchestra, conducted by r John Barbirolli. Nixa NCT 7000.

n exceptionally good record of a new phony, played for the first time in land during my visit last year.

aughan Williams is an old man now, and unsteady. But he still attends certs when his work is being played, I could only admire the stubborn age and independence with which he le his way unaided up the steps to the form to receive the applause of the ience, and to shake hands with the ductor and the orchestra leaders.

he free use of effects in this sym-ny are perhaps symptomatic of his lively mind, and a determination to phasise the fact that the old can still young.

ut there is nothing really new in ook in this symphony.

eyond the well-known Vaughan Wil-ns sounds and progressions — even uding a variation of the Lark As-ding in the third movement—there ttle said and that quite simple.

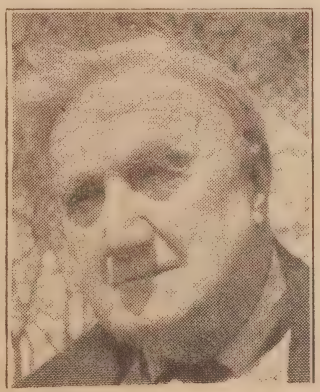
he "effects" movement, the last, does n somewhat incongruous against the eral mood, and strongly reminiscent a "hi-fi" demonstration record.

ut for all that, it is interesting and asant to hear.

here are some strange, extraneous es during the third movement which could be a chair creaking or Sir John's asthma, but they add little to the end result.

Technically it is bright throughout, with a full, rich sound. Without doubt, many will welcome this chance to hear an authoritative version of what may be the composer's last big work.

The jacket contains a reproduction of the autographs on the original score, which include the complete orchestra, and some notes prepared by the composer.



Ralph Vaughan Williams

Introducing

the New GRAMPIAN magnetic CUTTERHEAD

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which makes High Fidelity Disc Recording available to Everyone!

This unit is a development from Messrs. Grampian's type "D" feedback cutterhead and has similar mechanical and electrical constants but is operated from a single winding. It may be used in conjunction with any high grade power amplifier.

The cutterhead is of the balanced armature type, the resonant frequency of the armature being about 9 Kc. this high resonance being achieved through using an armature of pivotless design, the usual pivots being replaced by hollow torsion bars. Since the resonance is so high, the frequency response is fairly flat between 500 c/s to 4,000 c/s, thus making the sensitivity independent of acetate loading, especially when using "hot" stylus technique. the main resonance of the system is damped by the use of Silicone fluid, contrary to rubber or plastic damping materials, Silicone fluid remains virtually unaffected by changes of temperature.

The price paid for the advantages of the high resonance condition is the increase in the stiffness of the system thus requiring more power to drive it. However, present day techniques make it relatively simple to achieve high power outputs from audio amplifiers with low distortion and it is recommended that the cutterhead be used in conjunction with an amplifier capable of providing at least 25W output at low distortion.

While normal recording levels may be obtained with an input of 6 watts approx., a much higher peak power is required to deal with transient sounds and the rising frequency response necessary with the present day recording characteristics.

An average peak level of 7 volts is required for normal 78 r.p.m. recordings and 3-4 volts for L.P recordings.

TECHNICAL DATA

SENSITIVITY .. 3 Volts input for 1 cm/sec. at 78 r.p.m.
IMPEDANCE .. .. 15 ohms at 1000 c/s.
FREQUENCY RESPONSE .. plus-minus 3 db—50 c/s to 10 Kc.—6 db at 20 Kc.

DISTORTION .. .. 2% at 1000 c/s.
WEIGHT .. .. 6½ ozs. (184 grams).
STYLUS HOLE .. .. .. 0.064" or 0.0625" as required.
DIMENSIONS .. Height 1⅞" Width 1½" x depth 1¼".

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RCHMANINOFF—The Bells; f the Dead. Played by the iladelphia Orchestra conducted ugene Ormandy. Coronet 08.

these compositions came from ne period—about 1906—and have ich mates them with the piano s and symphonies now so

are descriptive pieces, dramatic in ways, and both good listening

Island of the Dead is a tone- describing a painting of some slands near Naples to which a bearing an oarsman, a draped nd a white figure.

Bells includes soloists and choir, he words of a poem by Edgar oe concerning four bells—silver, rass and iron—birth, marriage, nd death, as the jacket tells us. are extremely good.

not care much for the strangled a the Bells, but the others and ir are much better.

rding problems have been eased ng fairly well back so that there listress with mixed voices. The are brought out separately, and ance has a concert air to it. It out best, I thought, in the final where the baritone is the star ner.

e is a recording of Ansermet and Siss Orchestra for comparison in s of the Dead, and, as usual, he more subtlety than his contem-

andy's effects are rounder and his ng isn't as forward. But they are ne recording efforts.

good to see some of these lesser- works of Rachmaninoff becom- ilable, for he is not nearly such ed composer as many believe.

RAHMS—Variations and Fugue n Theme of Handel Opus 24; rmezzo in E flat minor Opus No. 6; Rhapsody in G minor s 79 No. 2. Played by Mal- nski. Columbia 33OCX 1382.

Intermezzo and the Rhapsody sed me more than did the Vari-

latter work is very weighty s, and it needs more inner re- ulness than Malcuzynski can nd.

effect he has upon me is rather o define. One can usually accept ormance with which one does not providing the performer has logic position and presents it consist-

cuzynski doesn't seem to have ed this. He interpolates phrases andles their shape in a manner often contradicts what he has loing.

impression is almost of improvis- as though next time he is likely the passage in a different manner. st no good starting out on a work this without having completely all its problems and their relation h other.

on't really feel that the pianist here e full measure of the Variations. uld be possible to get a more pene- version.

ir recording is a bit disappointing er remote and sometimes dull, a few slightly doubtful notes. The r pieces are much better.

surface is a very good one and well with the RIAA curve. The

Herbert von Karajan

frequency range isn't of a type which responds to much addition or subtraction.

BEETHOVEN—Symphony No. 2 in D major, Opus 36, Coriolan Overture Opus 62. Played by the Philharmonia Orchestra conducted by Herbert von Karajan. Columbia 330 CX1227.

I was most impressed with the sound of this record, and with the big, majestic Beethoven it represents.

Karajan is not given to taking his music lightly, and certainly not his Beethoven. There are some recordings of this symphony with a lighter touch, but none of them has its stature.

The Philharmonia Orchestra responds as though it was quite at home. I don't think I have ever heard a better demonstration of its size and weight.

I suppose we can't have it all ways, but there is a hint of oppressiveness in the heavy passages which goes with this kind of balance. It may even be a limitation of single channel, and I am still hoping to come across a disc which manages to avoid it without prejudice to the full sound that we get here.

There are several quite good recordings of this symphony, notably one by the Concertgebouw, and another by the Sydney Symphony Orchestra.

But I must admit this is the one I would choose myself.

Coriolan opens up on side one — it's rather strange to find an Overture used as other than a fill-up. Obviously, the movements fitted in best that way, and you can take in the Overture in its right place if you like, without getting from your chair.

My only criticism concerns the third movement. I would have liked the Trio played it a bit slower. Karajan's military and unswerving pace detracts, I think, from the proportions intended by Beethoven.

Aren't we hard to please?

MOUSSORGSKY—Boris Godounov, excerpts from the complete recording, featuring Boris Christoff. HMV QALP 1323.

Boris Christoff is one of those fortunate singers for whom there is no substitute or rival in his own field, even if this is mostly Boris Godounov and three different roles at that.

The only other voice which can be compared is that of Chaliapin, and then only to a degree.

Chaliapin would never have equalled Christoff as a recording artist purely as a singer. His voice was not as good, but his sense of drama was superb, and his stature, not to be hidden even under the handicap of primitive recordings, was magnificent.

His Boris was in the tradition of the early century, when the stage was the stage and you played it in full heroic style.

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This work has just been published in London, and the first shipment will be to hand on 12th June. Order now, since this initial supply is limited. There are over sixty pages of condensed, practical and authoritative information, and the book covers—besides ordinary radio servicing—FM, printed circuit and transistorized receivers.

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Christoff, although equally succe in his own style, portrays a more mate, human Boris. Chaliapin man struck with horror at the fate threatened him; Christoff, a man come as much with the enormity deeds as the punishment which ahead.

He is aided by the microphone possibilities he uses with the gr skill, and which displays his great control as nothing else could.

This disc, which selects key from the opera, is virtually a Ch recital, for the other singers are against the impact of his voice and sonality.

The few words uttered by Feodor attempts to calm his father in this scene, are ludicrous by comparison absorbed was I in the drama that a moment, I wondered what the noise was.

The orchestra handles the eerie often hair-raising atmosphere very indeed, and the choir singing, to good.

I would have liked to have hear "parrot" scene included in the ex from Act 2, and perhaps a little made of the closing pages. On the hand these can easily become over-a dramatic when heard without see and some underplaying could have the best course.

To Chaliapin, the Death of Boris his biggest moment, with every pulled out.

A comparison between the two formances gives the key to the differe between the two men as artists.

If you cannot have the full opera record is the next best thing, and i many tremendous moments.

Use the RIAA curve.

TCHAIKOVSKY — Sympho No. 5 in E minor Opus 64. Play by L'Orchestre de la Societe d Concerts du Conservatoire de Par conducted by Georg Solti. Dec LXT5241.

The only competitive version I is one by Karajan released some ago for Columbia.

There is a marked difference betw his performance and that of Solti.

The latter takes the music at a almost rattling pace. It rather sk over the emotional turmoil which K jan analyses at some length, and an introspection possibly too nounced.

Solti is occupied more with the sc than the music, as though afraid of doing the agony.

An ideal performance must ex equal emphasis on both, and it is easy to get the mixture just right.

But if Solti is concerned with sho off the orchestra, he does it pretty There isn't a great deal of reverbera in the hall, and it is quite fascinatin note how many of the parts are cle audible in the mass of orchestratio

If you can stand high volume, a little bass to it and stand clear. It give you plenty of thrills.

Nowhere is the difference between two versions more evident than at commencement of the last moveme where Solti's fast moving, clipped t ment and shattering brass contrasts Karajan's long, almost ominous phr and imposing build-up.

A special note is due to the b particularly the high trumpets, w

e authentic "tear" to them, and ood-wind, whose quality is ly French.

he whole, I would be inclined to Karajan's record which, although n't highlight so much of the has more real weight and takes sic more seriously.

hat's just my opinion. This is a c, and the more exciting of the

RIAA curve is OK with perhaps f extra bass. The surface seems

ETHOVEN — Quartet No. 8 Minor Opus 59 No. 2 (2nd umovsky); Quartet No. 11 in F r Opus 95. Played by the arian String Quartet. Columb 30CX 1236.

Hungarian players continue their ed progress through Beethoven's with this new issue.

I find this a disconcerting habit ven is rather sensitive in the matempo, and cannot be treated with ny liberties if proportion is not r.

fast pace is not just a matter ing more quickly than most. They is though they are in a hurry; as they are falling over each other haste to get through the notes, umble forth with a breathlessness is often disturbing.

the same kind of haste which numerous solo experts, whose acility and technical command hem to do things which their prers and contemporaries could not and rarely attempt.

Opus 95 seems to suffer most his treatment. Even the bright ovement is tossed off too smartly significance to be realised.

there is little doubt that, for all fficulties they create for them- the Hungarians produce some playing.

a pity they are in such a hurry!

The recording is similar to that of earlier releases — good enough but not brilliant. The balance is quite good but the recording as a whole could have been more intimate and gained much thereby. It's a concert hall effort.

The surface on my copy was almost completely quiet.

WAGNER — Toscanini conducts Wagner, Excerpts from Tritan and Isolde, Gotterdammerung, Meistersinger, Lohengrin and Parsifal played by the NBC Symphony Orchestra conducted by Arturo Toscanini. RCA LB 16025 (two records in album).

These discs will be welcomed for a number of reasons, chief of which is that they are conducted by Toscanini, one of recording's most fabulous names, despite the poor service he has received in the past from recording engineers.

Toscanini has a big Wagnerian reputation, and there are reasons for it. He has the ability to achieve perfect orchestral control, and any orchestra in the world would play its fingers off for him.

His sense of line and musical shape have always been superb. He has few equals in moulding sound; his judgment of rise and fall are almost mathematically exponential; he can sustain an orchestra down to inaudibility just as faultlessly as he can judge the relative power of its climactic capacity.

His touch is here, and all these things are here. I do not think he has retained the full sensitivity of earlier years, but there is little other evidence of the passage of time.

Is there some warmth missing? I think there is, but that was always his way. The recording has something to do with this, for it retains the aloofness of sound which maybe Toscanini demanded. It is concert hall, and neither its dynamic nor frequency range is very great by modern standards. Supplementary boosting won't do anything for the bass which is too light.

Cutting amplitude is rather low, although there is some slight groove echo, and RCA has allowed a few bumps to get through. Some surface noise, too, but the sound is very clear.

But there is great beauty and magic to be heard—sincerity, too, and distinction. If you value these, you'll overlook some minor shortcomings.

EDWARD ELGAR—Pomp and Circumstance Marches 1-5; Overture Froissart. Played by the London Philharmonic Orchestra conducted by Sir Adrian Boult. HMV OALP 1379.

Some tremendous recording in this disc. We get down to it immediately with the famous No. 1 March, the Land of Hope and Glory.

If it doesn't thrill you, nothing will. I remarked recently on a Philadelphia version as missing the authentic air of the music.

If you want to know just how it should be played, with that mixture of swagger, brilliance, grandeur and color that Elgar had in mind, this is it, and not

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MG 50058 STRAVINSKY—PETROUCHKA Burlesque in Four Scenes (complete recording). ***Antal Dorati conducting Minneapolis Symphony Orchestra***

NLP 903 GUSTAV HOLST — THE PLANETS: Mars, the Bringer of War; Venus, the Bringer of Peace; Mercury, the Winged Messenger; Jupiter, the Bringer of Jollity; Saturn, the Bringer of Old Age; Uranus, the Magician; Neptune, the Mystic (with chorus). Members of the London Philharmonic Choir. Philharmonic Promenade Orchestra. Leader: Joseph Shadwick ***Conducted by Sir Adrian Boult.***

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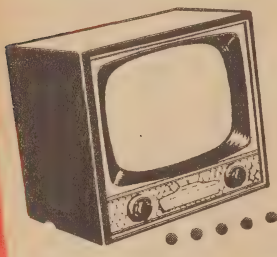

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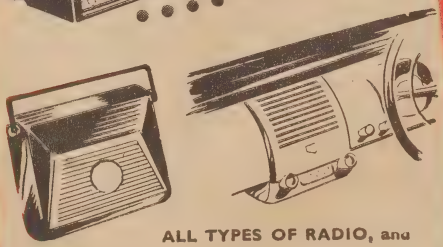

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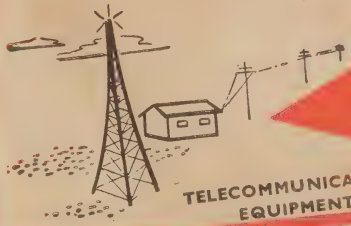

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ct that spine-tickling that only
ke this can produce.
se of this, and because of the
success in what it sets out to
ve it five stars.
he RIAA curve, and if you dare.
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a, conducted by Igor Marke-
DGG 18 167 LPM.**

record was made a couple of
go, and I have heard it several
nce then.
it better on each hearing.
is one other version which
the high spots with more aban-
though heaven knows this one
it enough. But none other has
subtlety and sensitivity, or a
sense of drama and urgency.
magnificent work should be in
lection of every serious music-
ot only for itself, but also for
portance of Berlioz in musical
and the fine example of him
it represents.
orchestral playing is really fine.
and is not very forward, but the
balance is the thing, and hasn't
ettered by DGG.
ice and engineering are first class

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), Tzigane, Kaddisch, Piece en
e de Habanera, Berceuse. Play-
y Zino Francescatti and Artur
m. Coronet KLC 540.**

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n and piano recording as you are
o meet up with in a long time.
true that the violin projects itself
ear at times with great intensity.
t more so than it would if you
itting close to it, as the micro
undoubtedly was. In most ways
daring, but completely successful,
tirely to the technical perfection
n men.
r ensemble is admirable.
sonata is rarely heard, and is
ing and amusing, more than it
able. The first movement is the
the second "Blues" movement
long for its content, and the
brilliant, but unconsequential for
erage listener.
remaining pieces at times find
ay as encores or in small groups

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at concerts. I doubt whether Ravel wrote anything else for violin and piano

Whether the performances are in the best Ravel style, I will leave to you At least you can be assured of impeccable workmanship and front-rank recording.

The surface, too, is noiseless.

MOZART.—Requiem Mass in D minor, K626. Played by the Philharmonic Symphony Orchestra of New York, conducted by Bruno Walter. Coronet KLC 543.

Mostly by Mozart, and finished after his death by Sussmayr, this is an uneven work, as one might expect, although most people who acquire it will probably know well its much publicised story.

It is recorded with more reverberation than anything I have heard for some time, and, although in a large hall it would undoubtedly sound that way, a good deal of definition is lost thereby.

Why this method of recording should have been used is not altogether clear as it should have been possible to strike a better balance. So don't look for full definition—rather for atmosphere and effect, for stained glass windows, rather than for multiple mikes.

Much of it is extremely beautiful, presented in this way, and all of it is shaped lovingly and sincerely.

All the singers are good, although the tenor blends least well and the alto lacks some strength and fullness.

I found the low organ passages came through best, particularly in the beautiful Recordare (which I thought the best section of all), with a notch of extra bass.

JAWBONE OF AN ASS—Cuban Jazz from Santiago de Cuba. Cook 1083.

This is one of those on-the-spot records made by Sam Eskin, recording engineer.

I am not an expert on the authenticity of Cuban music, but this disc has all the earmarks of it.

Some of the bands are obviously professional players of some sophistication —others may not be smooth enough for New York but they ring true.

Incidently, the Jawbone of the Ass is actually a jawbone, teeth and all, which are clicked in some numbers to heighten the effects.

The recording is excellent, particularly of the Trio Lissabet, although the mixture of items makes it sound rather uneven.

But if it is the genuine color and entertainment you want, this one is for you.

BORODIN—Polovtsian Dances and March from Prince Igor; LIADOV—Eight Russian Folksongs; SOKOLOV, GLAZOUNOV and LIADOV—Polka from Les Vendredis. Played by the Philharmonia Orchestra conducted by Nicolai Malko. HMV ODLP 1092.

Competent and vigorous playing under the hand of Sydney's new conductor—not altogether shot with the wild abandon of the Polovtsian camp (which was very wild) but with plenty of good, rich sound.

The Liadov folk songs contain some most interesting and tuneful pieces, very much in the Russian manner of the time. The final Polka, written in collaboration by Sokolov, Glazounov and Liadov, isn't so good.

As always, the Philharmonia is delightful to hear.

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SHORT-WAVE NOTES BY ART CUSHEN

4VWI HEARD ON 15416Kc

The logging of the new Haitian station on 15416 Kc. in this area will enable readers to hear more of this new outlet of the popular 4VEH broadcaster.

The hearing of the 4VWI transmitter on the 15416 Kc channel has been mentioned by European listeners for some weeks, and we are pleased to report the interception of the signals in this area. As well as being heard at 8 pm the station can also be heard in the transmission from 11 am to 1.30 pm, at which time the program is also carried on 9659 and 6105 Kc.

Although it has been heard directly in Europe, we have heard a relay of 4VEH, Cap Haitian, Haiti, on the 19-metre band. The signals on 15416 Kc are only fair on opening at 8 pm, but on Saturday the station opens with a session of replies to letters from listeners, from 7.30 pm. The signals of 4VEH, using 9645 Kc, are much stronger, and the program being of a missionary nature generally commences with a session of organ melodies.

OPENING ANNOUNCEMENT

The station opens with a march and then the identification is given in French. The opening announcement, in English, is "You are tuned to the Evangelistic Voice of the West Indies, transmitting from Cap Haitian, Republic of Haiti, in the West Indies. Our post office address is Box 1, Cap Haitian, Republic of Haiti. We operate on stations 4VE, 4VEC, 4VWI, in the 13, 16, 19, 31, 49 metre band and on medium wave. We appreciate your reception reports, all correspondence is acknowledged and should be sent to the Voice of the Evengelistic. Our post office box number 1, Cap Haitian, Haiti, West Indies. If you would like a schedule of our broadcasts, address your report to us at Box 1, Cap Haitian, Haiti, West Indies. Your letters will be acknowledged and all letters will receive a program schedule."

From our readers

BRAZILIAN signals have been puzzling our Benalla, Victoria, listener, Arthur Harris, who has been hearing fair signals at 7 pm from the Rio de Janeiro station, PRL7, operating on 9720 Kc. The station has been heard with a news service with both announcers reading portions of the session. The signal is spoilt at 8 pm when there is interference from the Peking transmitter on 9730 Kc. The Sao Paulo station on 11765 Kc, ZYB8, has been heard from 8 pm, with severe inteference from VOA on 11770 Kc. The interference makes reception somewhat difficult, but a news session is generally heard when the station opens.

Indonesian Air Force Radio transmitting from Djakarta has been the centre of some hours of listening for Kevin Dunham, of Narrandera, NSW, who hears the station from 7.30 pm. The station opens with a recording of an aircraft in flight and over a period of three minutes included many passes over the recording point. Then follows a march and a program of popular dance music, generally American discs which are somewhat dated. The station uses the slogan, Angkatan Udara. It is a military station and operates 7.30-10.30 pm, also uses RAU1, 5975 Kc, RAU2, 2575 Kc, powers being 7500 and 500 W.

Prague adds 19 metres

TWO 19-metre channels have been brought into service by Radio Prague, Czechoslovakia, with the normal transmission at 3 pm. The station is operating on 15145 Kc, OLR5E and 15280 which has no call assigned. The service is also transmitted on OLR3A (9550) OLR4H (11835), and on 11935, a frequency which has no call assigned

News of the stations readers are hearing, and enquiries about unknown stations should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are Eastern Australian.

ANGOLA SIGNAL REPORT

ANGOLA transmissions, which are so rarely heard in this area, have been reported by the Middle East correspondent to Radio Australia, who mentions that the Luanda station CR6RF, using 9592 Kc., and it is operated by the Radio Club of Benguela. Signals are only heard from 3.30 to 3.45 am, when at this hour Tangier with VOA transmissions opens on 9500Kc. CR6RN in Luanda has returned to 4865Kc., and suffers interference at this hour from the Kotanau station on 4870Kc. at 4 am.

TAIWAN has been using the 16-metre band, when they are using 17815Kc, in parallel with 15345Kc. The transmission is from 3.00 to 4.00 pm and news in English is released at 3.05 pm. Taipeh has also been herad on 15345Kc. in chain with 11815Kc., when the station opens at 9.30 pm, reports August Balbi from California.

LATEST TRANSMISSION SCHEDULE FROM AFRICA

SABC BROADCASTS

THE latest transmission schedule from the South African Broadcasting Corporation, has been released by Radio Australia. As these transmitters, with the new increased power of 20Kw, are much more easily tuned in this area, the schedule in part is reproduced below. The transmitters are listed in separate groups but this is only for transmission reasons, and the three sessions, English, Afrikans, and Commercial, are each carried on two transmitters carrying the programme in parallel.

ENGLISH PROGRAMMES

4810Kc.: Mon.-Fri., 2.30-3.30 pm, and 2.19-7.15 am, Tue., Sat. Saturday. 2.40-4.30 pm and Sunday, 2.09-7.45 am. Sunday. 3.55-4.42 pm and Monday, 2.19-7.15 am.

9680Kc.: Mon. to Fri., 4.38-6.30 am; Tue.-Sat., 12.04-2.15 am; Saturday, 2.38-4.30 pm and Sunday. 12.04-2.05 am. Sunday. 4.36-6.15 pm and Monday, 12.34-2.15 am.

11900Kc.: Mon.-Sat., 6.34 pm-midnight; Sunday, 6.19-12.30 am; English transmission, 2.

7229Kc.: Mon-Fri., 2.30 pm-3.30 am; Sat., 2.30 pm-3.50 am; Sun., 3.55 pm-3.25 am.

3316Kc.: Tue.-Sat., 3.22-7.15 am; Sun., 3.35-7.45 am; Mon., 3.29-7.15 am.

AFRIKANS TRANSMISSION 1

4895Kc: Mon-Fri., 2.30-4.30 pm; Tue.-Sat., 6.35-7.15 am; Sat., 2.40-4.30 pm; Sunday, 2.34-7.45 am, 3.55-4.45 pm; Monday, 2.34-7.15 am.

9533Kc.: Mon.-Sat., 4.38-6.00 am; Tue.-Sun., 12.30-2.30 am; Sun., 3.39-7.00 pm; 12.30-2.30 am.

11840Kc.: Daily, 6.04 pm-12.26 am.

AFRIKANS TRANSMISSION 2

7275Kc.: on.-Sat., 2.40-2.45 am; Sundays, 3.55 pm-2.45 am.

3376Kc.: Tue.-Sat., 2.49-7.15 am; Sunday. 2.49-7.45 am; Monday. 2.54-7.15 am.

COMMERCIAL PROGRAMME

Transmission 1

4945Kc.: Mon.-Sat., 2.00 pm-4.15 pm; Tue.-Sun., 2.05-8.00 am; Sunday, 3.00-4.15 pm; Monday. 2.04-7.00 am.

9720Kc.: Mon.-Sat., 4.19-6.15 pm; Sun., 4.19-6.45 pm. and daily, 12.19-2.00 am.

11937Kc.: Mon.-Sat., 6.19 pm-12.15 am; Sunday, 6.49 pm-12.15 am.

Transmission 2

7295Kc.: on.-Sat., 2.00 pm-3.00 am; Sun., 3.00 pm-3.00 am.

3356Kc.: Tue.-Sun., 3.04-8.00 am; Mon., 3.04-7.00 am.

AFRICA SERVICE

15230, 25820 Kc.: Daily, 9.00 pm-4.00 am.

The programmes of the Africa service are in Afrikans for Monday, Wednesday, Friday and Sunday and in English on Tuesday, Thursday, and Saturday, according to this latest schedule, which has been released by Radio Australia.

FLASHES FROM EVERYWHERE

TAIWAN is the site of a new high-p transmitter, which was opened early in Ma is operating on 9607 Kc, according to a release. This new tranmitter of the casting Corporation of China was not sch for operating times, so this one will be g log of readers we feel in the next few

FINLAND has a new schedule for Europ So in America, which includes news in and English every day except Monday. The uses 15190 and 17800Kc., and is on the a 9.00 am. Transmission to North America 100-3.00 pm. Monday to aSturday, the mission is from 1.30 to 2.30 pm Sund Finish and Swedish, while on other da four languages are in use.

CUBAN signals from the Havana station have been heard by Kevin Dunham, of We agree with him that this station has from 9360 to 9400Kc., and it is heard latter frequency from opening at 8.30 pm first portion of the program consists items, each item followed by a commercial nouncement and the station slogan. "Radio gresso Havana." The entire program Spanish, and can be heard till after 10 pm

TIFC in San Jose, Costa Rica, as well as heard on 9645 Kc. in the afternoons in the missionary programs to 3 pm, is pr good signals on opening at 10 pm wh gramme is in Spanish.

ARABIC broadcasters which have been on many frequencies of late, have in the been from new freedom type transmitters broadcasts directed against the present E Government, while another has been hear the Egyptian version of the present prop war in the Middle East. The transmitter itself (Huna Sawt el Hak (The Voice and Right) is located in Aden, while seven stations in the same network broadcast France and Tunisia. International Short News of London also indicated that the on 7105 Kc., "Huna Sawt el Arab", is at Abu Zaabal, Egypt, and diffuses can against nearby countries using the Cairo transmitters.

JAPANESE time and frequency statio which is often heard on its channels of 2 2Kw, 15,000Kc.; 2Kw, 4000Kc., and 8000Kc., 500W. The 4000 and 5000 Kc. mitters are expected to be withdrawn thi and replaced by continuous operation 10,000Kc. The station is located at the Research Laboratories, Koganeimachi, Tok Stations have been heard with English ann ments on the hour, when on 10,000Kc. the mission is generally mixed with WWV, W and MSF.

ISRAEL appears to be testing a new mitter, as last issue we reported the recept the station on 9555Kc., and this month a from England places the test broadcast 11765Kc. These tests from Tel Aviv ar carried on the normal channel of 9008Kc English 6.00-6.15 am daily. The new sch which is to come into effect from the bro from Israel, has the English news broadc ised to be released at 7.00 am.

NEW ZEALAND has been heard on evenings at 8.00 pm to 8.45 pm with a test mission directed to the New Zealand For Malaya. The station was using the ZL2 and ZL3 (11780). The other special trans from Wellington is also aired on Sunday from 6.15 to 6.45 pm a transmission is d to the New Zealand party wintering at Base in the Antarctic. This transmissio been carried on 11780Kc., but this fr has been varied slightly to avoid the i ence.

SOUTH AFRICA, which has had an mental transmission on 25800Kc., for months, has increased the schedule of the and 17 transmission is now operating 9.00 pm to 4.00 am. The transmission is t on Africa, but has been heard in this area high frequency signals are in favor.

BRUSSELS, with the experimental Wor transmission, is now being heard in thi and should remain good during the winter station is using three frequencies from B namely 11850, 9745, 9765, and over the La ville relay on 9655 broadcasting from th glan Congo, the program is heard each day from 9.15 am.

HE HAM BANDS WITH BILL MOORE

ateurs in NSW, following the successful VHF communication tests with bush walkers, being called upon to assist in searches for persons lost in our difficult mountain country.

mateurs in NSW were again called out the Search and Rescue Section of the of Bush Walkers' Clubs to assist in for two persons lost north of Spring- the Blue Mountains.

ish walker had previously arrived at to report on the condition of his anions who he had left in a cave gged mountains of the Grose Valley. request of the section, on Anzac Day- s proceeded to Springwood to set up ions and provided bush walkers with alkie" sets.

ase station was operated four miles manned by Horry Lapthorne, VK2HL, Miller, VK2AF, contacted the port- The second, manned by Bob Winch, worked with Sydney stations. t, VK2HO, and Adrian Rofe, VK2HE, provided telephone contact with the and Penrith police. Amateurs also the operation were John Thornthwaite, complete with "Walkie-Talkie" in Walkers' advance party.

ole, VK2VL, also with a "Walkie- unit, proceeded to the edge of the ge to ensure that communication with the river bed was possible. 4MC portable units were provided by VK2VL, and VK2ATO and base stations 1 and VK2OA.

ally, the two missing walkers found out down the river. When base ted of this fact, within half an hour h parties were recalled via the radio

al transmission was made at 2.30 pm Friday.

hole operation was conducted without and due credit must be given to the who participated. It is the second hin three months that the VHF group called out to assist in searches for bushwalkers. Its members are carry- effect portion of our code that runs s: "The amateur is patriotic, his know- nd his station are always ready for f his country and his community."

he search for DX

nteresting insight into the amount of ne that has to be spent to keep among names in the DX field is provided by Bill Lippman, W6SN, who announced ement from the fray after recording ntries confirmed.

In the ARRL DXCC Bill has been in the top ten bracket on the honor roll for over four years. He states he is just tired of the effort required to keep up among the leaders.

According to Bill, much of the fun of hamming has drained away, due to the necessity of continuously monitoring the amateur bands waiting for the unusual prefix to show up, thousands of hours spinning the dial without touching the key, and allowing your friends to call without answering in case a new country is missed.

Bill suggests in a letter to QST that perhaps some of the other DX leaders would like to break away from the grind of logging new countries and follow his example of retiring.

You seldom hear the calls of the amateurs, who lead in the DX field unless an expedition has journeyed to some outlandish QTH. The rest of the time they are just slowly tuning. DX-hausted was the word used to describe Bill's complaint.

Amateurs in the Antarctic

AMATEUR radio has been playing an important part in boosting the morale of the personnel of many nations resident in Antarctica.

US nationals are very fortunate that the regulations permit handling third party messages back to the people at home.

W1BCR has already been awarded the Navy Distinguished Public Service award for his work in the relaying of messages from Antarctica.

A total of seven stations, operated by US amateurs, will be set up in the south. Most of them are already active. They are as follows: KC4USA—Little America, KC4USN—South Pole, KC4USV—McMurdo Sound, KC4USB—Marie Byrd Land, KC4USK—Knox Coast, KC4USH—Cape Adair, KC4USW—Weddell Sea. The stations are set up and maintained by the US Navy solely for the use of amateur radio operators.

Some indication of the number of messages handled can be seen from KC4USA and KC4USV's log for eight months' operation in 1956. 3000 messages were recorded in and out besides the normal contacts with the world's amateurs.

One interesting first was a QSO between KC4USA in Antarctica and WQCXX on a Strato-Cruiser near the North Pole—communication pole to pole.

The Easter Convention

RADIO amateurs in Melbourne over the Easter holidays spent many hours discussing current and anticipated problems that do or could beset our hobby. That city was the scene of the Federal Convention of the Wireless Institute of Australia.

Delegates from WIA Divisions in VK3, VK5, VK6, VK7, VK9 and a proxy representative from VK4 assembled together with members of the Federal executive of the WIA and spent over 20 hours in session.

Details of the decisions reached on the varied agenda items will be published in Amateur Radio.

Federal president, Bill Mitchell, VK3UM, was in the chair. Conventions of this nature are essential to ensure that amateur problems are viewed on an Australia-wide basis. They also provide the means of resolving differences that appear unsurmountable via letter.

VHF news from VK4

IN the April Hidden 144 Mc/s Transmitter Hunt the location was well selected by last month's winner, Jack VK4JO.

The signal received by the "hunters" was fairly weak but John VK4FP and Allen VK4ZAE managed to land at the correct spot in the Pinkenba area.

Groundwork for activity from Gympie on 144 Mc/s was carried out over Easter by John VK4ZAG. Signals should soon be radiated by one of the locals.

A meteor streaking across the sky seemed to cause a peculiar flutter on the signals of Ross VK4ZAT, who was returning home late one night after working mobile on 144 Mc/s with Mick VK4ZAA.

By now many of the AOLCP Z stations will have gear working on the 56-60 Mc/s band recently allotted to them.

Mick VK4ZAA will soon be moving into a new shack—even has taken his old 3 over 3 down.

Don VK4ZAF erected a new tower and beam over Easter. Efforts of Rick VK4VR and Brian VK4ZAP to haul a 40ft pole on a small sedan were swiftly stopped by the local police.

The annual convention will again be held at Palm Beach in June—get the gear ready, chaps, to use in the many field events. The above notes were contributed by John VK4ZAG.

VHF in NSW

WINNER of the VHF section's surprise scramble on 144 Mc/s after the VK2WI broadcast was won by Phil James, VK2ER. The VHF gang were very glad to welcome Bill Barden, VK2ABZ, back to 144 Mc/s after a serious illness.

NSW VHF President Perc Healy, VK2APQ, journeyed to Melbourne, complete with walkie-talkie unit under his arm and surprised some of the 144 Mc boys down there. He also looked in on the WIA Federal Convention held over Easter.

European program for IGY

THE following is a brief summary of the suggested IGY projects for radio amateurs in Europe.

UK amateurs—Study of aurora and related transmission condition on HF amateur bands, UK-Canada route.

Study of relationship between VHF/UHF propagation and meteorological conditions.

Study of auroral communications on VHF amateur bands.

Reception observation of solar noise in VHF/UHF bands.

Belgium—Investigation of intensity of reception of chosen frequencies.

Observations of fading, fade-outs, abnormal signal strengths, flutter, echoes and other phenomena.

Relative measurement of background noise, especially on decametre waves. Meteor whistles on decametre waves.

Denmark—Study of auroral communication on VHF amateur bands (the amateur national society, the EDR, will operate special station OZ7IGY on 144 Mc/s).

Germany—VHF/UHF propagation observations in collaboration with ionospheric sounding stations. The special duties have been selected in view of the geographical location of each country.

ather Fine for Nth. Coast Convention

glorious weather, amateurs and their illies enjoyed the entertainment and con- ovided at Urunga, scene of the North VIA Convention, held over Easter. following amateurs attended: VK2APS, VK2PR, VK4TM, VK4VS, VY2AYE, VW2FH, VK2AQI, VK2AEY, VK2RU, VK4GG, VK2ADT, VK2ARV, VK2PY, G, VK2ACU, VK2AHA, VK2XT, H, VK2XO, VK2JC, VK2JK, VK3ALQ, VK2ADN and VK2EA.

ate WIA members attending included eid, Brian Starke, Ray James, Bob Norm Dash, Norm Moody, Harry Miller, cAuley.

g Friday evening an informal discussion ace with amateurs airing their viewpoint y subjects.

ration was conducted on the Saturday om then on the conventions developed eries of operating events for many ama- attendance.

etition results are as follows:—
er 1 Hidden Transmitter Search:
Noel Hanson, VK2AHH, 37 contacts.
Bill Hall, VK2XT, 90 minutes.
er 2—144 Mc/s Hidden Transmitter

Harold Whyte, VK2AHA.
Norm Moody.
John Pickles, VK4FP.
Challender Memorial Contest:
Noel Hanson, VK2AHH, 79 points.
Harold Whyte, VK2AHA, 55 points.
Don McKenzie, VK3ALQ, 54 points.
Hunt:
John Pickles, VK4FP.
Fred Reid.
ga Scramble:
Noel Hanson, VK2AHH, 37 contacts.
Allan Williams, VK2FH, 35 contacts.
3rd—Bill Hall, VK2XT, 32 contacts.
Ladies' Blindfold 144 Transmitter Hunt:
1st—Mrs. VK2ACU.
2nd—Mrs. Bailey.
Gentlemen's Blindfold 144 Transmitter Hunt:
1st—John Pickles, VK4FP.
2nd—Harry Miller.
Lucky Door Prizes:
Mrs. VK2ACU and Bill Hall, VK2XT.
Farthest Distance Travelled:
Don McKenzie, VK3ALQ.
Guess the Magnified Object:
Mrs. VK2AHH.

The following firms and individuals were kind enough to donate prizes and so create so much competitive interest in the field events:—

Varley Filton, VK2SF, United Radio Distributors, Amalgamated Wireless, A/sia, Philips Electrical Industries, Mullard-Australia Pty. Ltd., Australian Electrical Industries, the NSW Division of the WIA, Urunga businessman Ney Westcott, Radio Television and Hobbies, and two anonymous donors.

As with all conventions, the success of the event depends on the work of the organisers and the following were to the fore on this occasion.

Zone officer Noel Hanson, VK2AHH, for general organisation.

Chief, VK2XO, and his wife Jean entertaining the crowd at their "Do Me" shack on Saturday evening. Chief's slides were appreciated as were views of past conventions by Ken, VK2PY, and John, VK4FP's, film of the VK4 Palm Beach convention. Brian Starke and Fred Reid very effectively "lost" the 144 Mc/s transmitter, and Bill VK2AWG, Rod VK2ACU, and Alan VK2FH were all very active while Norm Dash acted as convention secretary-treasurer.

When planning next year's holidays, don't forget Easter and Urunga. These events always provide excellent comradeship and entertainment

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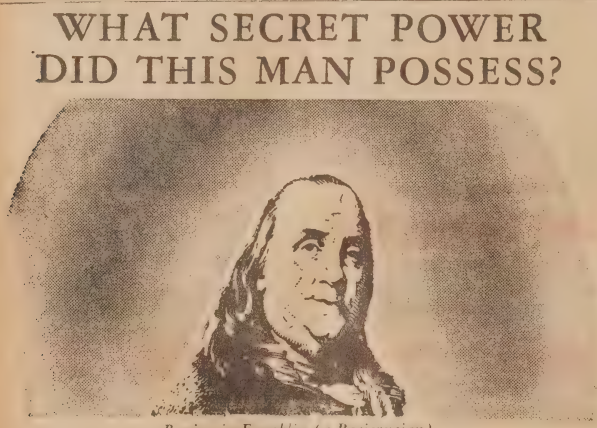

Benjamin Franklin (a Rosicrucian)

Why was this man great? How does a one—man or woman—achieve greatn Is it not by mastery of the powers wi ourselves?
Know the mysterious world within y Attune yourself to the wisdom of the a Grasp the inner power of your mi Learn the secrets of a full and peac life! Benjamin Franklin—like many o learned and great men and women—w Rosicrucian. The Rosicrucians (NO religious organisation) first came America in 1694. To-day, headquarter the Rosicrucians send over seven mil pieces of mail annually to all parts of world.

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...national Conference

...n by the various national authorities ...dy commenced in preparation for the ...rnational Telecommunications' Confer... ...n the US, main work has centred ...e setting up of various committees to ... frequency allocations, technical prob...

...ntatives of the amateurs, ARR1 gen... ...ger, A. L. Budlong, W1BUD, and as... ...neral manager John Huntoon W1LVQ ... the two inaugural meetings arranged ...Department of State. As in the past ...e will continue to have representation ...committees whose decisions have any ...n amateur radio.

...L card information

...SL cards being received these days ...not show sufficient information of the ...be acceptable for many of the major ... awards.

...n undoubted advantage, if one is very ...nd makes out many cards, to keep ...mation that has to be written, to ...

...early days it was quite popular ... much information on cards as pos... ...m the weather to the height of th... today the general procedure is to re... written information.

...ard may be important to some ope... ...teur, who wishes to submit it for an... Most societies granting DX award... ...ertain information to be clearly shown ...cards. Signal reports are important ...imum of R3 and S3 is set by the ...Make certain, too, that QSL's confirm ... not merely show your signal... Committee examining the later in ... cannot decide whether such a card ... QSO or not.

...tain to mention the band on whic... ...ct has been established. It is neces... ...f instance, for the Empire DX certif... operation on other bands besides ... is an essential feature of the award ...affect claims for a 3.5 Mc/s WAC if ... is not clearly shown. The date and ...the contact is on phone or CW are ...uired to be shown.

...rangement that should cover all re... ...s and keep writing to a minimum. ...s:

...die ..... confirming our ...e ..... Mc/s contact on ..... 19 ..., at ..... our signals, RST ....nformation shown above and not an ...can be struck out.

...ral News

... the necessity of digging deeply into ...mercial telephony QRM, 7 Mc/s is worth ...it in the mornings. From 5.30 am to ... some excellent prefixes appear. One ... provided EA6AF, CT3AB, EA8AX, and ...good DX on any band.

... new prefix appearing on the 14, 21 ... Mc/s band is OH0—Aaland Islands ...) has been active from the islands, this ...s been added to the DXCC countries.

...hose interested in the WAZ award ...lists Zone 18 stations as UA0, KAB ...AD, KAG, KOA, KSB and KUO. ...19—UA0, KCA, KGA, KGO, KFA ...FF, KFG, KFO, KJA, KJB, KKB, KKF ...I KQC.

... is the latest station active on Ascen... ...nd—total two stations, he uses 20 watts ...c/s CW.

..."Race for Life", the French film with ...ur radio theme, has been awarded the ...Nations' Award for 1956 for the best ...trating the principles of the charter of ...ed Nations. Amateur radio is surely ... publicity at high levels these days.

... published last year that UK amateurs ...ndle messages for the British Red Cross ...during emergencies was an important ... British amateurs. Latest details avail... ...w that they may now also co-operate ... St. John Ambulance Brigade on pre... ...same lines.

...that the Z call amateurs will be per... ...o use the 56-60 Mc/s band will be ...with satisfaction by most members of ...y.

...y on the band of late has been restricted ... influx of new stations should assist ...ecording of information of use to the ...horities. The band will provide an out... ...he undoubted enthusiasm of the LAOCP ... and an opportunity for interstate and ...contacts.

...cture on capacitors

...AM HALL, VK2AGH, lectured at the ...il meeting of the NSW Division. As ... is an engineer with Ducon Condensers, ...ct was naturally "Capacitors". He sup... ...ta sheets for various types of capacitors ...e samples, both duly appreciated.

...nformation supplied on negative, zero, ...itive co-efficients was particularly inter... ...d the members' attention was completely ...was reflected by the number of questions ...at the lecturer at the completion of the ...

...intended to make a tape of the lecture ...ulation among country members.

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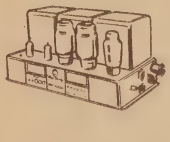

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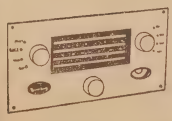

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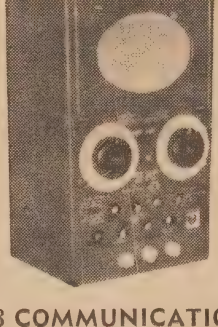

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1J6	12/6	12SL7	12/6
1K4	12/6	39/44	10/0
1K6	12/6	46	12/6
1LH4	12/6	47	12/6
1P5	12/6	78	12/6
6A6	12/6	828	£2/10/0
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3B7	10/-	957	6/6
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806	£7/10/0	83	10/
6V6	12/6	FM1	12/6
1K7	7/6	866A	17/6
6X5	12/6	1Q5	12/6
1P5	7/6	6AC7	3/6

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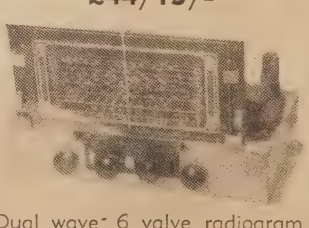

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A SIMPLE COURSE IN RADIO

Continued from Page 47.

al ase pin. American practice was co ect the grid to the top cap, while E ope the plate was often brought o top.

Th reduced grid-plate capacitance, to he with other characteristics peculiar th screen-grid construction, allowed chigher amplification to be achieved ra o frequency amplifier stages with ger of instability.

ta lity was further improved by in- li a metal screen to enclose the ve or alternatively spraying the en- p with a metallic coating, which be connected via a base pin to nd or to the chassis.

n modern miniature valves, careful g and small size has largely obvi- he need for top-cap connections etal shield cans. Plate and grid ntions are brought out to pins on ne sides of the base socket and e are built into the basic electrode re.

E SCREEN GRID

h screen grid was found to have ring effects on the electrical char- r ics, quite apart from the reduc- grid-plate capacitance.

e g operated at a substantial posi- tential with respect to cathode, it lso attract electrons from the latter n the same way as the plate. Thus, electrons are collected by the posi- reen, but the big majority simply rough its open mesh and proceed ds to the plate.

rever, the screen assumes a marked ll over the plate current and, ng generally, we may say that the current in a screen grid valve de- very largely on the applied screen e, and to a lesser extent on the voltage.

is reflected in the changed values le resistance and amplification fac- hich are important and basic valve teristics.

ead of being a few thousand amps, ate resistance is more like 0.5 to egohm; amplification factor in- s from 10 or 20 times to a figure eral hundred; transconductance is eatly effected.

t and best known screen grid valve country was the old type 24A, is interesting to compare charac- s and curves for this valve with of the type 27 triode of the same l period.

NDARY EMISSION

hough the screen grid represented nct advance, it introduced certain ties, chief of which was the so- SECONDARY EMISSION effect. moving electrons strike the plate alve at high velocity, they tend to ate its molecular structure and dis- other electrons, which are thus y "bounced" off into space.

ause this action is an incidental of main electron stream from the e, it is described by the general f secondary emission. The effect lent in triode valves, but it does d to ill-effects, because the second- ectrons are immediately attracted o the positively-charged plate.

screen-grid valve, however, the ely charged screen tends to attract f the secondary electrons so that an electron flow is evident in the reverse direction between plate and screen.

It is most noticeable when the screen voltage is equal to or greater than the plate voltage. This can occur easily in normal operation, when the control grid receives a positive signal impulse and the instantaneous plate voltage is reduced sharply.

Hence, secondary emission, by producing unnatural effects in the plate current limits the amount of plate current swing and offsets partially the advantages of the screen-grid structure for some circuit applications.

USE OF PENTODES

The ultimate solution to the secondary emission problem was offered by the addition of yet another grid—this time located between screen and plate. The resultant five electrode valve came to be known as a PENTODE or PENTHODE The SUPPRESSOR grid is usually a very open spiral and is generally connected internally or externally to cathode

Being negative with respect to both plate and screen, it tends to reduce the velocity of electrodes approaching the plate in the normal manner, and diverts back to the plate the slow-moving electron produced by secondary emission.

Pentode valves are widely used nowadays in all classes of service. For radio frequency amplification they have superseded the screen-grid type, typical modern RF pentodes being the 6BA6, 6BHF and 1T4. Other pentodes have been designed especially for audio voltage amplification (types like the Z729 and EF86) and audio power amplification (types 6F6-G, 3S4, etc.).

The modern beam power valve makes use of a different principle to suppress secondary emission. There are the four major electrodes—cathode, grid, screen and plate, but they are so shaped that secondary emission from the plate is prevented without an actual suppressor grid

BEAM PLATES

Because of the way the electrodes are spaced, electrons travelling to the plate slow down almost to zero velocity in a certain region between screen and plate. In this region the electrons form a dense cloud—a space charge. The effect of this space charge is to repel secondary electrons emitted from the plate and thus cause them to return to the plate.

Two additional electrodes known as beam forming plates, which are connected internally to the cathode, are so placed as to concentrate the electrons emitted to two beams, on opposite sides of the oval cathode.

Another feature common to beam power valves has the effect of reducing greatly the screen current. The helical coils of the screen and the grid are wound so that each turn of the screen is shaded from the cathode by a turn of the control grid. This alignment of the screen and grid causes electrons to travel in sheets between the turns of the screen so that very few of them flow to the screen.

The ultimate effect of forming the electron stream into horizontal and vertical beams, together with the reduction of screen current and other refinements, results in beam power valves being very efficient in operation. Typical beam power valves are the 6V6-GT, 6L6-G, and the transmitting type, 807.

It is possible to make quite a long story about valve design and development, for the evolution of the pentode structure has not by any means satisfied all requirements. Special circuit arrangements have brought the need for pentodes with a wide variety of characteristics. For example, SUPER-CONTROL or VARIABLE-MU pentodes have been evolved to permit smooth control to be achieved over the gain of a receiver.

MULTIPLE VALVES

Furthermore, numerous valves have been developed and released which contain in the one envelope two or more distinct electrode structures. Most rectifier valves contain two diode structures, but twin triodes and even twin pentodes are not uncommon. Some valves contain two diodes and a triode or pentode unit in the one envelope, while the battery-type 1D8-GT contains no less than a diode, a triode, and an audio power pentode—all within its small glass bulb.

Yet another distinctive class of valve is that intended for use as a frequency changer in superheterodyne receivers. This special subject has yet to be explained, but it is sufficient to say here that valves with no less than five grids—hence called PENTAGRID CONVERTERS—are in common use.

Other valves intended for the same purpose have a triode and another complex structure in the one envelope, the two being independent or interconnected, according to the particular design.

STANDARDISATION

Physically, there is a like variety in design. Envelopes may be of either glass or metal, and fitted with bases having anything from 3 to 9 or more pins. Some glass envelopes are sprayed with a metallic coating, and overall size ranges from 6 to 7 inches in height to less than an inch for special types. The beginner can do no more than keep a very open mind on the whole subject, becoming acquainted with the characteristics of particular types, as they are met with in practice.

There is, unfortunately, little standardisation in the manner in which valves are depicted schematically. Generally, however, the filament is shown as an arc at the bottom of a large circle representing the envelope.

A larger arc or a straight line in proximity to the filament indicates the presence of a cathode sleeve.

A solid or open rectangle at the top of the circle depicts the plate, while the various grids are shown by dotted or zig-zag lines between cathode and plate, generally in the same progressive order as they are found in the actual valve.

Typical valve symbols are shown in figure 9, but only familiarity will enable the student to interpret all circuits without hesitation, because of small departures from the usual practice.

Physical and electrical details of the various valves are given in valve data charts released by most valve manufacturers. The various type numbers are listed in alphabetical or numerical order followed by details as to type, dimensions, base connections and electrical characteristics. It is a good idea to obtain one of these charts and spend an hour or so studying its columns.

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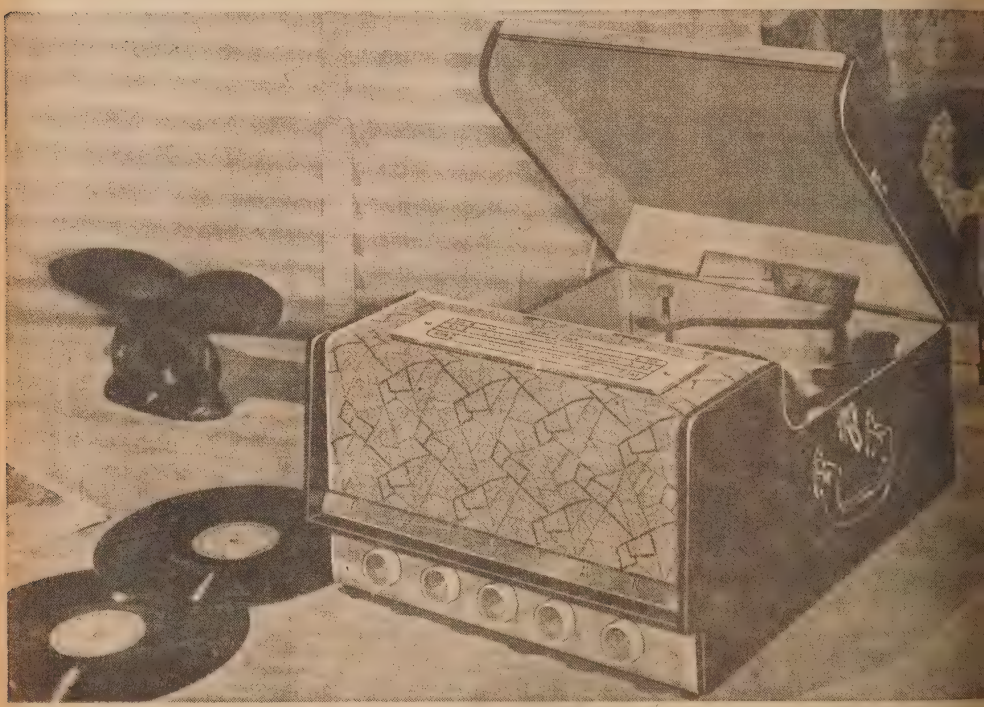

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Let's Buy An Argument

(Continued from Page 83)

Well, then, since heat rise is the chief limiting factor in rating a resistor, it is both sensible and consistent to quote the limit in terms of electrical watts of dissipation.

We are all familiar with the carbon resistors about ¾in. long and 3-16in. diameter, which are rated at 1-watt maximum dissipation. Whether they can stand this load safely and continuously is another matter, which we won't debate here.

However, taking the rating as read, a given resistor could either be rated 0.1 meg. 1-watt, or 0.1meg. 3.1mA. This last rating would save K.S. having to work anything out for himself.

But the same type of component, having lower resistance, could be used with somewhat higher current. Thus a .05mg. 1-watt resistor would have to be marked .05meg. 4.5mA. And so it would be for every individual value in the range.

For general use, such a system would be hopelessly cumbersome. People couldn't be expected to remember the current ratings for each individual size and value, so that lengthy charts would have to be issued. Alternatively, if the current rating were to be stamped on each, the current problems with color codes and/or numbers rubbing off would be doubled.

It's ever so much easier just to be able to recognise resistors as ½-watt or 1-watt types, and do a bit of figuring when the need arises.

Just for good measure, we reprint also a letter from another "old-timer". He was apparently playing around with radio circuits when a good many of the rising generation were occupied with much more juvenile pastimes, such as dropping bags of water out of dormitory windows.

I can't speak from experience with the circuits mentioned because, as far as I can recollect, my push-pull activities at the front end of a set were confined to push-pull diode detectors, which went the same way.

My general reaction to most such schemes is that their most eloquent condemnation is their failure to stand the test of time. One must presume that the advantages they conferred were outweighed by their additional cost and complexity. Or perhaps it became easier to achieve the same results by other techniques.

But why spoil a perfectly good argument by saying too much at the outset? Maybe there are other readers who for years have been carrying the torch for some forgotten circuit.

And don't worry about wasting our time, as A.F. has mentioned. It's of such stuff that arguments are made!

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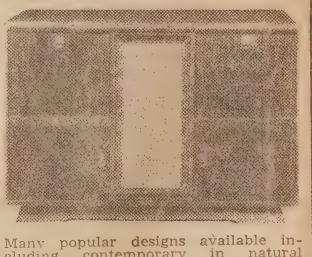
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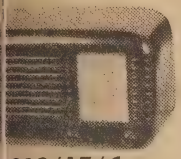

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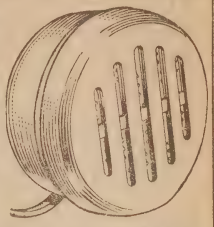

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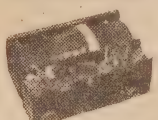

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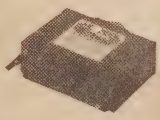

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Long Spindle .. ..

NSWERS TO CORRESPONDENTS

idale, NSW) has constructed the er described in the September, 1956, ds that when charging a 4-volt bat- indicates 4 amperes.

ting of the charger is 3 amps and e exceeded if damage to the recti- avoided. Unless it is a very small ttery is not likely to be damaged current. The first thing to check meter is indicating correctly since this order is not uncommon in small meters. If the meter proves correct increase the value of the ballast ohm 30 watt) or alternatively simply ge on the lower range where the amps as measured by the meter. ntage is then that you would not charge a 2-volt cell. We have not the values of dropping resistors for d 135 volts from the Personal Power it should not be too hard to deter- experimentally with the aid of a

(armarine, Vic.) is anxious to see the 17in TV receiver published. He also the tuner.

ou can see we have already made a right direction. The new receiver er already described and although we the design further as indicated in it has proved perfectly satisfactory inal areas. We regret that we were ublish a parts list at the time, but luded in the May issue. A parts list nd section is in this issue.

Devonport, Tas.) wants to know if scribed any equipment suitable for d of model boats.

ies of articles appeared in the Sep- tober, and November, 1950, issues nd Hobbies, dealing with the radio model aircraft. There is no reason cannot be applied equally well to s. Unfortunately, these copies are vailable, but you can probably refer your nearest public library.

vanhoe, Vic.) wants to know if we tescribed radio suitable for use on a

suggest you refer to the February, C.R.S., which contained a "Reader rticle along these lines. The circuit ne Reinartz Portable of March, 1953, of either of these issues are avail- e can supply reprints of the circuits th the query service in the normal

lengowrie, SA) is interested in the Cost Crystal Amplifier and Small ut wants a wiring diagram for these fe suggests that we make this avail- th the query service.

thanks for the suggestion, R.H., but that it isn't quite as easy as all that. m is one of time more than space, it be appreciated that the preparation rawings takes a lot of time. Once g is made it is normally just as easy sier) to publish it in the magazine e it available through the query ser- can only suggest, R.H., that you do others like you have done; give it ite of your diffidence. You'll find it you think in most cases.

Prospect, SA) sends details of a tran- he has built around one of the latest type transistors. It uses an RF stage roxcube rod aerial.

g thanks for your letter and details. nd we will file your letter for pos- In the Reader Built It page. In the we may comment that the switched y be undesirable limitation in many ugh we appreciate that it would simplify n.

Cudmore Park, SA) has had trouble ough sensitivity from a combination 7W Ultra-Linear Amplifier and the ntrol Unit. There is adequate gain on ner but not from the pickup.

ildering the lengths to which you had get full output we would say there thing very wrong with either or both e fact that a tuner was able to drive ely does not discount this possibility, ner can often deliver several volts of Rather than rebuilding the system we would be far better to try to locate and duplicate the performance of the We appreciate your comments about tages and we may do something about e future.

(Kalamunda, WA) is interested in the Course in Television" and would like me of the earlier articles in the series missed.

A. We have, at the present time, a complete file of spares from May, 1956, onwards. There are also a few odd copies before that date and we would be glad to forward your requirements The cost is 2/- per copy and postage is free. There is no definite plan to reprint the series at the present time but it is possible that we will do so later. No doubt the idea of three-dimensional television transmission has been considered in the large research laboratories of the world but practical difficulties in maintaining even a simple monochrome television transmission are such that it is likely to be a long time before such systems are considered seriously on a commercial basis.

I.M. (Auckland, NZ) would like to use the Playmaster Tuner No. 3 with Playmaster Baby No. 4 amplifier. His query concerns the current drain of the tuner and capabilities of the amplifier power supply.

A. The amplifier should be capable of supplying the current requirements of the tuner and could actually be used with the tuner coupled directly to the amplifier high tension line. However, there would be some argument for using a dropping resistor in series with the tuner high tension lead. We suggest that you use a 2000-ohm 3 watt resistor. A 1 watt unit of the same resistance would be within its ratings and could be used if you already have one on hand. Thank you for the kind remarks regarding the amplifier.

K.G. (Kingsgrove, NSW) forwards the circuit of a B battery eliminator which he feels may be of interest for the "Reader Built It" page.

A. Thanks for the circuit which we will keep in mind. We can't make any definite promises, however, especially as your idea is one we have frequently published in the past.

N.W. (Brisbane, Q) wishes to know where he could purchase the relay as used in our "Photo Timer".

A. The relay, used in the prototype Photo Timer, was obtained from a disposals dealer, but it should be possible to purchase one through other sources. We suggest that you contact some of our advertisers of either new or disposals equivalent, who should be in a position to advise you regarding the availability of suitable relays.

T.L. (Coburg, Vic.) is a new reader who wonders if it is possible to adapt an ordinary broadcast receiver to receive shortwave.

A. Yes, T.L., by placing a shortwave converter ahead of an ordinary receiver, excellent reception of overseas stations can be obtained. In fact, from the point of view of reducing image reception the converter/receiver arrangement could easily be better than a dual-wave receiver. A number of shortwave converters have been described in Radio, Television and Hobbies the most recent being a single band unit in the June, 1955, issue and a two-band version in the July, 1955, issue. There are also some simple types employing only one valve. All are available through the 2/- query service Our thanks for your appreciative remarks.

W.L.C. (Wellington Point, Q.) writes to the serviceman in appreciation of his recent comments about an old-time autodyne radio, and relates his experiences with a similar set. In particular, he describes how he salvaged a rattling speaker by filing a 1/64th in. off the speaker core.

A.: Many thanks for your comments W.L.C., and we will pass your letter on to the serviceman. As you suggest, the speaker treatment was rather drastic, but such steps are often justified when there is little to lose. Perhaps if you keep this set going long enough it may qualify as a vintage set!

A.D.L. (Epping, NSW) encloses an advertisement, and at the same time asks if we intend describing any 2-metre equipment in the near future.

A.: We can't make any promises about the near future, but we certainly will describe some more equipment for this band at some time in the future. We agree that it would be popular particularly in view of the technicians' licence, which limits operation to the high frequency bands.

B.H. (Roseville, NSW) asks some questions about valve substitution.

A.: There are probably a number of valves which could be used in place of the 1Q5-GT's specified for the radio control transmitter in the September, 1950, issue. In addition, there are probably many valve types which could be used successfully, given minor circuit modifications. Unfortunately, we cannot spare the time to go into details, but the 3S4 and 3V4 would be well worth trying. The switched-tuned oscillator described in the March, 1953, issue operates with a very low voltage supply and the reserve is not very great, so that there is a possibility of difficulty with the 3S4. We would not like to be more definite without a trial. Also note that most satisfactory results in this circuit were obtained with the Bramco coil.

J.M.E. (Gosford, NSW) writes concerning a 5-valve set in which the power transformer had burnt out. Accordingly, J.M.E. replaced the transformer and electrolytics, but now has high tension on the valve grids.

A.: As you have not supplied any circuit details, we can only assume that the set uses back-bias, and that the back bias resistor has become open circuit. This would cause symptoms similar to those you have experienced. We suggest that you replace this resistor with another of the same value.

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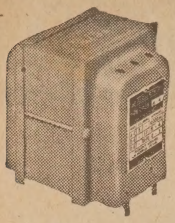
Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cut-outs in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.



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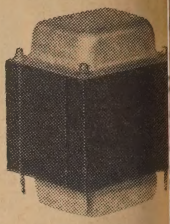

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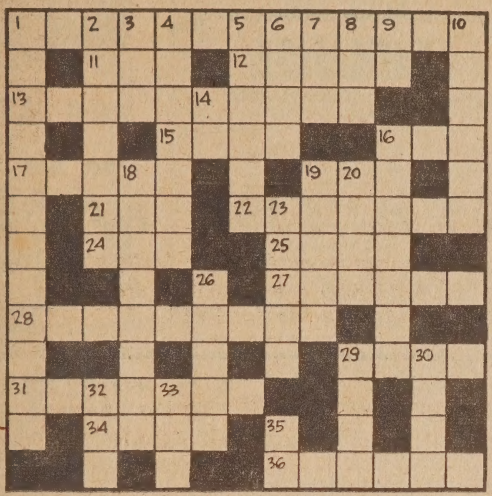


CROSS

Studio TV programs (2 words).

Institution of Radio Engineers (abbrev.).

Angry.

Type of bridge used in measuring resistances.

Borders of a piece of cloth.

Prefix meaning three.

River in Europe.

Pronoun—feminine.

And not. The Henry or unit of inductance.

Gasoline (abbrev.).

Solitary.

Capacity of a body for doing work.

Reciprocal of capacitance.

One.

Flow of electricity.

Scottish island.

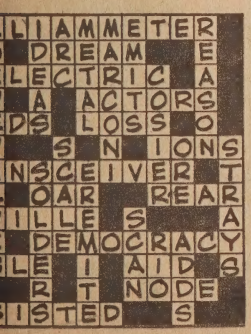
36. Radiating or receiving wire of an electromagnetic wave.

DOWN

1. Audible rates of change are in this category (2 words).
2. To be looking at.
3. Period of time.
4. Ties up with a rope.
5. Used as an indicator of acidity.
6. God of love.
7. A metal vessel.
8. Chewed and consumed.
9. South East (abbrev.).
10. A sequence.
14. South East (abbrev.).
16. Capital of Iran.
18. Biblical ship (2 words).
19. A town in New England (NSW).
20. Whetstone.
23. Choose by vote.
26. One of the United States.
29. Union of Soviet Socialist Republics (abbrev.).
30. An atom, jot.
32. Returned Soldiers' League (abbrev.).
33. Organ of sight.
35. South Australia (abbrev.).

Solution and further crossword next month

t month's solution



S.F. (Newcastle, NSW) would like to see some 2-m equipment for radio amateurs described in Radio, Television and Hobbies. He has in mind particularly those with limited amateur licences.

A. We agree that many readers would like to see some VHF equipment described and as soon as the pressure of television projects eases down we will do something practical in the matter. You may have noted recently that the 56 Mc/s to 60 Mc/s has been opened to limited licences and as both transmitting and receiving equipment on the band is somewhat easier to construct and adjust there may be some argument in making a start on 5 metres rather than the higher frequency.

W.L. (Rotorua, NZ) queries the socket connections to a valve as published in Radio, Television and Hobbies.

A. In cases where the suppressor grid of a pentode valve is internally connected to the cathode, we sometimes draw it as a tetrode, ignoring the suppressor grid and its connection to the socket. Our reason for doing this is that it tends to make the schematic diagram look less frightening to beginners. It makes no difference as far as the wiring is concerned. Obviously, where a suppressor is brought out to a separate pin, it must be included in the diagram.

P.G. (Southport, Qld.) queries our statement that it is very hard to receive shortwave stations on a crystal set and at the same time details a relatively simple circuit which he has been using for reception on 148 Mc/s.

A. While it is possible to receive 148 Mc/s stations on a crystal set, such reception is the exception rather than the rule. Possible conditions are very strong field strengths due to close proximity, unusual propagation conditions or exceptional behavior of your aerial due to chance optimum characteristics. Many thanks for the kind remarks regarding the magazine in general.

D.R. (Ballarat, Vic.) sends us a circuit of a one-valve set taken from an English magazine and wants to know whether a transistor may be substituted for the valve and what alterations would be necessary.

A. In the first place, D.R., the set is really a two-valve type, the valve being a twin triode. More important, however, is the need to appreciate that transistors are not simple "plug-in" substitutes for valves. Their characteristics are altogether different and call for a completely different approach in circuit design. It is, therefore, quite useless to start with a valve circuit with the idea of converting it to a transistor circuit, except in the very broadest terms. Transistor sets must be designed as such. We hope to publish something along these lines in the next few months if present experiments are successful.

A.R.G. (Dee Why, NSW) is puzzled by the apparent lack of interest in and development of new ideas which are announced from time to time. In particular he draws attention to the germanium diode which was described in Radio and Hobbies for December, 1946, and wants to know why no more has even been heard of this device.

A. We can only assume that you have missed out somewhat on your technical reading of late, A.R.G., since the germanium diode is now well established in industry and used extensively in many applications where it has advantages over the diode valve. We have specified it for use in several crystal sets, as well as in the recent FM Tuner. You may rest assured that we will not overlook it in any other applications where it is suitable. However, it is important to realise that it is still often more economical to use a conventional valve diode, particularly when this is available virtually "free" in a triode or pentode valve of the diode-triode, or diode-pentode variety. Incidentally, we can find no reference in the article to which you refer to any method whereby the home constructor might "grow" his own crystals. In fact, such a possibility is unlikely, since the process calls for extremely precise manufacture.

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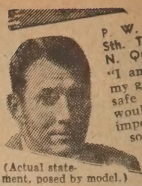

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